THE

ELECTRICAL REVIEW.

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MANUFACTURING FOR STOCK.

EVERYONE thankfully recognises that the demand for electrical machinery is increasing daily; but it is also true that the total manufacturing capacity of the world is making equally rapid strides, and that, so far as this country is concerned, the time will soon arrive when manufacturers will have an opportunity of getting ahead of their orders and of making stock. The peculiar conditions over-ruling the trading of the past have militated against, if not practically prohibited, this; but even were that not the case, manufacturers have had some justification for looking with misgiving upon capital locked up in stock.

Times are changing, however, and the requirements of yesterday necessarily vary from those of to-morrow, rendering it essential, in order to keep in the front, to adapt one's supply to meet the demand in every detail.

Considerable difference exists between manufacturing for stock and *making* to order, even if the machines so made are of standard design and output.

In the first place, it is very apparent that standardisation, which is the aim of every manufacturer, cannot be properly attained unless orders are executed from stock; in fact, as soon as deferred deliveries are quoted, departures from the standard are difficult to avoid.

In other words, as soon as an order finds its way into the shops, it becomes apparent to the buyer that the machine is to be made for him, and that he can introduce slight variations either to suit his fancy, or to suit more exactly the particular requirement for which he is purchasing it. Departures from the standard are thus involved which would not have been asked for if the machines had been ready on the shelf awaiting purchase.

At the present time American and Continental firms are executing their orders chiefly from stock, except for the larger sizes of machines. Some English manufacturers, on the other hand, are accustomed to passing orders into the shops, and except in the case of smaller machines, of requisitioning the raw material from the suppliers only on receipt of the order. In other words, although using standard sizes and patterns, the machines are only turned out in small quantities as orders arrive.

Whether it is correct to continue on these lines must be decided, first, by the nature of the demand, and secondly, by the question whether competitors derive any advantage from working in other ways.

It can be safely laid down that if the demand requires delivery from stock, the supply will be forthcoming, prices being adjusted, if necessary, to allow this to be done at a profit. On the other hand, if the demand does not actually necessitate this, but still foreign competitors find it advisable, to suit their methods of manufacturing, to execute their orders from stock, then British works must do likewise, in order to compete with them.

We do not feel disposed to lay down that the principle followed by competitors abroad is the correct one, because they happen to have adopted it, for their ideas of manufacturing, and the conditions under which they manufacture and sell, differ from those of British factories. We cannot help feeling, however, that they meet the requirements of to-day better than do English firms.

Everything seems to point towards a quick delivery being required for small machines up to about 50 KW., be they motors or dynamos. The numerous power distribution companies laying their networks in every quarter, are dependent largely for their profits upon the revenue obtained from the sale of power for motors, and it is hardly to be expected that the consumer will instal motors until the supply is available. As soon as it is available, however, no time is lost in changing from the old method of driving to the new, and motors are wanted almost at a day's notice. The same remarks apply to Corporation lighting stations, which are using every endeavour to popularise the use of motors off their supply.

Assuming, then, that quick delivery is required for the smaller sizes of machines, is there any reason why this should not be carried out? A motor can now be looked upon as a cut-and-dried production, capable of developing a specified horse-power at a certain speed, and there is no reason why it should not be carried in stock and sold over the counter. On the other hand, the demand for the larger sizes of machines, which are chiefly used as generators, does not seem to point towards the same quick deliveries being necessary. In fact, as the working conditions of generators vary a good deal, it seems at present difficult to standardise the windings sufficiently to carry them in stock; furthermore, a finished stock to meet the general demand would be too large to be practicable.

Then again, other arrangements have usually to be made before larger machines can be installed, arrangements such as buildings, engines, boilers, &c., and this seems to indicate that deliveries of two to three months are prompt enough to meet the demands, while in the case of still larger generators of, say, 1,000 to 2,000 KW., in all probability five to six months would meet the case.

Even these deliveries, however, point towards large stocks of raw material being kept, to enable the winding and assembling to be commenced shortly after receipt of order.

Delays of some months in obtaining small machines might sometimes mean that changing over to the electrical system would be deferred by some, who would otherwise be tempted to go ahead if they were able to give the system a speedy trial.

From an engineering point of view, there is no reason why every manufacturer should not work for stock in the smaller sizes. Although improvements in design and manufacture must necessarily come as time goes on, there is no reason why a stock should not be turned over sufficiently quickly to avoid risk of collecting obsolete patterns.

The financial risks entailed are not serious. A finished and part finished stock necessarily involves the locking up of considerable capital; but provided this stock is necessary for economical working, the capital so involved need be no more grudged than the money turned into bricks and mortar. The chief fear in many quarters seems to be that in the event of a lull in orders this stock may accumulate to such an extent that it has to be realised at a loss to provide the necessary ready money. That this is not only probable, but actually happens in practice, would appear to be instanced by the position in which many American and German manufacturers find themselves at the present time. But it does not follow that the danger of over-production would be increased when working on the stock principle. It is a question of judgment when to damp down the output of the factory to avoid over-production.

Those working on the stock principle, however (assuming the capital in either case to be the same), will have to damp down their output sooner than those who can first accumulate their stock before feeling the pinch of over-production to the same extent.

Quicker deliveries are becoming imperatively necessary, and it is to be hoped that the manufacturing capacity of this country will respond to the gradual change in the market requirements. If this is neglected, it is to be feared that some American and Continental competitors will have a decided pull, for other things being equal (and sometimes even that is not troubled about), the manufacturer who can deliver quickly is the one to whom purchasers will first turn.

We have endeavoured in these comments to show that both the demand and foreign competition warrant a change in the principle of manufacturing when the opportunity presents itself. At a later date we may be able to show that only when selling from stock can a successful sales organisation be established for dealing, not only with home orders, but what is almost more important, with the foreign and Colonial markets.

An Appeal for Those at the Front.

It will probably be a surprise to some of our readers to learn that there are still out "at the front" over a hundred of our electrical engineer volunteers. It would seem that there remains useful work for them to do out there, and we have great pleasure in drawing attention to the request which comes from Captain Pott, at the Headquarters of the Corps, that electrical engineers at home will remember those who will spend their Christmas away on active service. We trust that the response to this appeal will be hearty and prompt.

Electrical Engineer R.E. Vol.,
2nd South African Detachment.

Sir,—You are aware that there are over 100 members of the Corps of Electrical Engineers now serving in South Africa. The officers and men at home are therefore raising a fund to enable "comforts" to be sent out to the South African Detachment in time for Christmas.

Col. Crompton, C.B., has headed the list most liberally, and it is hoped that members of the electrical profession, and other friends interested in the work of the corps, will help by sending a subscription, however small.

To make certain of our stores reaching our men before Christmas, it is necessary to dispatch them within a fortnight, and therefore subscriptions should be sent to the undersigned without delay.

Yours obediently,
A. H. Pott (Capt.),

Headquarters E.E.R.E. Vol.
Regency Street, Westminster.

The German Patent Office.

It is well known that the United States and Germany are the two leading countries which make a strict examination of applications for patents before they are granted. There are, however, many and wide differences in the procedure of the United States and the German Patent Offices, and some of the most important of these are pointed out by Frank H. Mason, the United States Consul at Berlin, in the *American Machinist*, October 29th. Some of the hints given may be of use to inventors in this country. In the first place, a foreign inventor cannot deal directly with the German Patent Office. He must be represented by a German Patent Agent of recognised standing, by whom the application

and specification are presented, and through whom additional details or explanations can be asked for by the examiners. An invention cannot be patented in Germany if previous to the application (1) it has been disclosed in any generally accessible publication, (2) or has been publicly used or exhibited so that it could be carried out. In the United States, however, an invention may be patented any time within two years from the time it has been publicly disclosed. The construction of the claims of a German patent are the chief difficulty with the foreign inventor. In Germany, the first or principal claim must be a statement of the invention, and all other claims must fall within the same scope. It is inadmissible in Germany to introduce the solution of a new problem in the second or following claims, but any amount of "modifications" may be introduced in the subsidiary claims, provided the problem to be solved is the same as in the principal claim. In the United States, on the other hand, each claim must be complete in itself, which means that no reference must be made from one claim to another, and also that each claim must cover a combination quite separate and independent of the other claims.

Mains Plans.

By the Electric Lighting Act of 1882, undertakers possessing statutory powers are required, before laying down any electric line within 10 yards of any part of a telegraph line, to give at least seven days' notice to the Post Office, with full particulars of the works contemplated. A further restriction was embodied in the 1888 Act, wherein power was given to the Board of Trade to require that any electric line or work should be used only in accordance with such conditions, and subject to such regulations for the protection of the lines and works of the Post Office as the Board might think fit to prescribe. In the London Provisional Orders there is a section requiring undertakers to give one month's notice to the Post Office before commencing street works, and a plan of the proposed works must accompany the notice. The Post Office may approve of such works either absolutely or conditionally. This word "plan" is by Sec. 1 of the schedule to the Electric Lighting (Clauses) Act of 1899, defined to mean a drawing to a horizontal scale of at least 1 in. to 88 ft., and, where possible, a section drawn to the same horizontal section as the plan, and to a vertical scale of at least 1 in. to 11 ft. Owing to the extensive works now being carried out by the Postal Telegraph Department in connection with the telephone system, it becomes a matter of importance that the department should be acquainted with the location of street works belonging to electric supply undertakings, and in approving electric works recently, the Post Office has made certain stipulations which burden undertakers with new responsibilities. Whereas the plans previously required were of suggested works, and to a scale of 5 ft. to the mile, the Post Office now require to be furnished within one month of the completion of the various portions of such works with plans drawn to a scale of 10 ft. to the mile. On such drawings any high and low tension mains must respectively be shown by continuous and dotted lines, and the depth of the mains below the surface by figures inside a circle, and the variations in horizontal position relatively to the kerb and building line by plain figures without a circle, the position being indicated by giving the party walls or street number where charges occur. The requirements have been considered by some of the undertakers to whom they apply as unnecessarily onerous, and steps have been taken to lay before the Post Office authorities the difficulties which will be created in attempting to carry them out. Simple as it may seem to provide such details, it is only known to those who have charge of such works how many obstacles there are when an effort is made to prepare plans giving full data as to the location of mains in the public thoroughfare, and it is the general experience that gas and water companies rely more upon the personal knowledge of the distributing staff than upon accurate and detailed plans when it comes to the question of where their pipes are laid.

TRAFFORD PARK POWER SYSTEM.

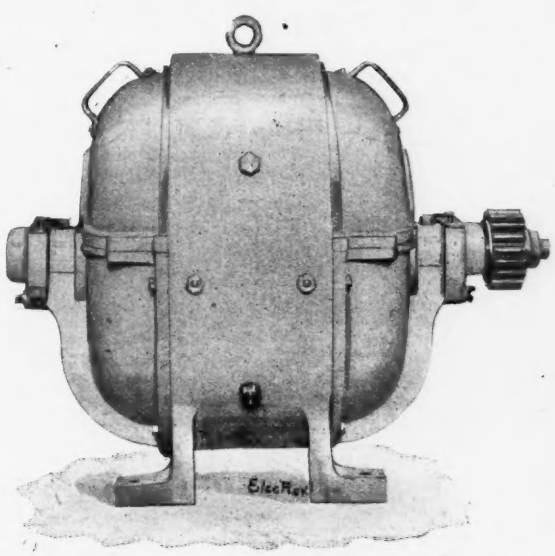
(Concluded from page 719.)

The coal is admitted to the producer by means of a plate valve fixed at the mouth of the hopper. This valve is hand operated by the men on the coking platform, which is shown in the form of a circular gallery round the top of the producer. From this gallery the men are able to stir up the incandescent mass of fuel undergoing combustion, by means of long pokers thrust inside through apertures in the crown of the producer.

These pokers roughly fit into holes drilled through turned pieces of steel, which are spherical in shape. Since these metal spheres are bedded into a sort of seating it will be apparent that the result is practically a ball joint, which admits of the poker being swayed in all directions without a serious leakage of gas taking place.

Steam is forced through the glowing fuel in the producer, and the resultant gas is led out at the back and near the top of the producer.

After passing through the vertical regenerative pipes and the dust box, the gas is led through the mechanical washers, which are two in number. Each consists of a rectangular vessel made of plates rivetted together. This vessel contains water, which is churned up violently by means of two dashers, essentially consisting of four fan-like blades mounted at right angles on horizontal shafts. Directly geared to these shafts by means of cast-iron spur-wheels and raw-hide pinions are separate "Royce" motors, which run continuously. These motors, four in all, are mounted on cast-iron brackets, in turn bolted to the girder work.



Standard Royce Motor.

After being thoroughly washed as above, the gas is led off through a 5-ft. main pipe to the distributing mains. A short bye-pass to the 5-ft. main is immersed several inches under water, with an open end, to prevent tar from the generating plant from creeping into the supply pipes.

The requisite pressure to force the air-blast into the producers is supplied by two "Roots" blowers, which were made by Messrs. Thwaites Bros., of Bradford, and are temporarily housed in a galvanised iron building.

Each of these blowers, one of which acts as a standby to the other, is electrically-driven by two "Royce" motors. One motor is geared direct through cast-iron spur-wheel and raw hide pinion to each end of the blower. The series-parallel method of control is again used here, the two motors lending themselves to this arrangement.

The controllers and instruments in connection with the washer motors are also fixed in the blower house, this arrangement being considered preferable to having any electrical

gear—beyond the motors themselves—on the gas-plant structure.

It will be seen that all the power required is supplied by electric motors, which are invariably geared direct, thus representing the latest practice. The figure on the previous page shows a sample motor.

It is the intention of the company to erect a "Recovery Plant" for the extraction of the bye-products of the Mond gas immediately the volume generated is such as to justify the additional capital expenditure.

System of Charging.—The schedule of charges is based on the maximum demand system, and is stated hereunder :—

Power.—1½d. per unit for the first 1,200 hours of maximum demand per annum, and ½d. per unit for all further units.

Lighting.—4d. per unit for the first 400 hours of maximum demand per annum, and 1½d. per unit for all further units.

These exceptionally low charges are only rendered possible on account of the high load factor mentioned above. The unique demand is such as to justify a load factor of at least 35 per cent. being permanently maintained. With electricity at the prices quoted, it will be seen that manufacturers and others in the neighbourhood cannot afford, with the maximum economy, to employ any other agent for either lighting or power purposes.

Extensions.—It is at once apparent from the unique position of the company that the question of extensions is no ordinary one. The demand for both three-phase and continuous current generating plant requires considerable judgment to discriminate as to the proportion one class shall bear to the other. This problem is further complicated by the necessity for ample standby accommodation for both kinds of current.

Bearing these considerations in mind, the third set (now in course of erection) was specified by the consulting engineers to be a double current generator.

This set consists of a Browett & Lindley 1,000-H.P. engine directly coupled to an "Allgemeine E.G." dynamo, the armature of which is fitted with both commutator and slip rings, and from which it will be possible to take continuous current at 500 volts or three-phase current at a corresponding pressure in any proportion desired. This set should be running in December this year.

The fourth set, now under contemplation, will in all probability be a three-phase alternator generating current at extra high pressure.

It will be seen, therefore, that No. 3 set, aided by step-up transformers, will serve as a standby to both the D.C. and A.C. generators.

There is a disposition on the part of the directors to gain an additional economy in the driving of the fourth set. This can be done by dispensing with two of the steps at present used to convert the energy of the fuel into its electrical equivalent.

Briefly summarising, it will be remembered that the coal is first converted to gas, the gas is burnt under the boilers to raise steam, the steam drives the engines and the engines the dynamos.

If the gas could be utilised in a gas engine, the boiler and steam engine could be dispensed with.

The difficulties of obtaining an engine of 1,000 H.P., operated by "Mond" gas, and capable of running for long periods without interruption, are at the present time very great, but these difficulties will, no doubt, be overcome in the near future.

Management and Staff.—The directorate is composed of men who are well known in the electrical world, and includes Messrs. W. P. J. Fawcus, Henry Edmunds, G. B. Samuelson, H. P. Holt, and Walter Taylor. The latter gentleman acts as managing director to the company, and much of its success is traceable to his untiring energy. Mr. Horatio Hawkins is secretary to the company.

Messrs. Lacey, Clirehugh & Sillar and L. B. Atkinson, who were jointly responsible for the inception of the scheme, acted as consulting engineers and prepared the whole of the contract drawings and specifications for these works, which have been carried out under their supervision. The design of the gas plant is due to the Mond Gas Corporation, Limited. Mr. S. Lynch is resident engineer, and Mr. H. Allcock, to whom we are specially indebted for the preparation of this article, chief electrical engineer.

The clerical work is much reduced by the use of the card system for all such purposes as consumers' index, meter and indicator diary, meter reading, &c., &c. The cards were especially got out by the Library Bureau, Limited, who took great pains to embody the ideas and suggestions of Mr. Allcock, in whose department they are chiefly used.

The gas plant has been carried out by Messrs. Goddard, Massey & Warner, of Nottingham, and Messrs. T. Davies and Son, of Openshaw, Manchester, under the supervision of the consulting engineers, who have most kindly allowed us every facility for making ourselves acquainted with the details of the power house. The scheme for the general distribution of the gas has been entrusted to Mr. Llewellyn B. Atkinson, of Cardiff.

HEYWOOD ELECTRICITY WORKS.

Heywood is a busy manufacturing town near Manchester, and has a population of about 30,000 inhabitants. A provisional order for electric lighting was obtained by the Corporation in 1898, and in the following year the Electric Lighting Committee appointed Mr. W. P. Adams to report upon the matter; shortly afterwards a commencement was made upon the electricity works. A site was chosen in a central position on land belonging to the Corporation, with a good clay sub-soil. The buildings comprise an engine house, boiler house, which is on a level 6 ft. lower than the engine room, battery room, pump room, coal store and offices. The chimney shaft is 120 ft. high, and is 6 ft. in diameter at the top. Ample space is left for extensions.

The designs for the buildings were prepared by the borough surveyor, Mr. J. A. Settle.

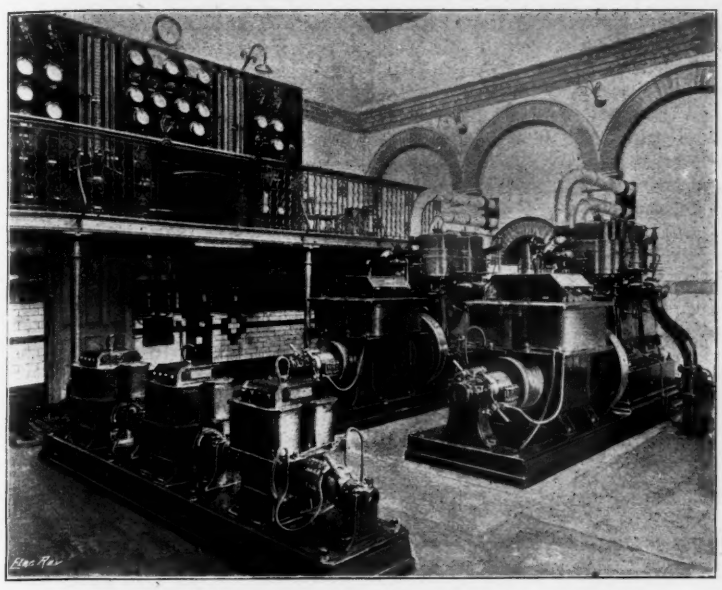
The contract for the complete equipment of the station was entrusted to Messrs. Crompton & Co., Limited. The boilers were supplied by Messrs. Tetlow Bros., and are of

Exterior of Electricity Works.

the Lancashire type, two in number, with Hopkinson fittings, working at 140 lbs. per sq. in. The steam piping is of steel, and is in duplicate throughout. The boilers, steam pipes, and hot water pipes are covered with the Mica Boiler Covering Company's lagging, which consists mainly of mica flakes, and has a very high efficiency.

A Green economiser of 96 tubes provides for heating the feed water; the scrapers are driven by a Crompton electromotor fixed to the roof of the pump room.

Both steam and electric pumps are provided, the latter being generally used. The steam pump is of Messrs. J. P. Hall & Son's make, of the compound direct-acting type, having a capacity of 10,000 lbs. of water per hour against



Heywood: Generating Plant.

boiler pressure. This pump has shown remarkable economy, and can be regulated so as to work at a very low speed. The electric pump is of the three-throw type, with the electric motor geared through spur gearing. Water can be taken direct from the town supply, or from a large cast-iron tank over the pump room.

Injectors have been fitted to the boilers as a stand-by.

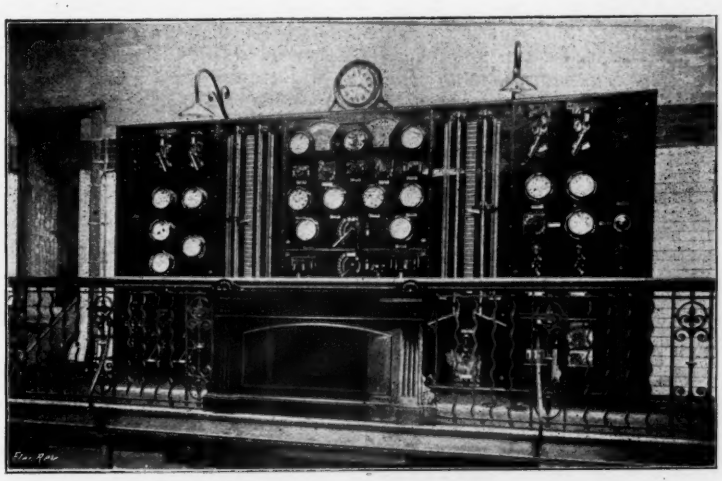
The generating plant at present installed consists of two 60-KW. sets, giving 120 amperes each at 500 volts, 500 revolutions per minute. The dynamos are of Messrs. Crompton and Co.'s make, of the two-pole undertype, and are shunt wound; provision has been made for adding series-winding in the event of their being used for traction.

The engines were made by Messrs. Reavel Bros., of Ipswich, and are of the compound two-crank enclosed type, with forced lubrication. The combined set gives an over-all efficiency of 85 per cent. at full load, and takes 34·8 lbs. of steam per KW.-hour, non-condensing. One set was tested without forced lubrication, and consumed 38·6 lbs. of steam per KW.-hour, thus showing clearly the effect of the system of lubrication upon the efficiency of the set.

Space has been provided in the engine room for additional plant.

A balancer booster is installed, consisting of two balancers, each giving 35 amperes at 200—230 volts, and a booster giving 60 amperes at 0—120 volts, at 1,000 revolutions per minute. An 8-ton overhead traveller, supplied by the Chatteris Engineering Company, spans the engine room.

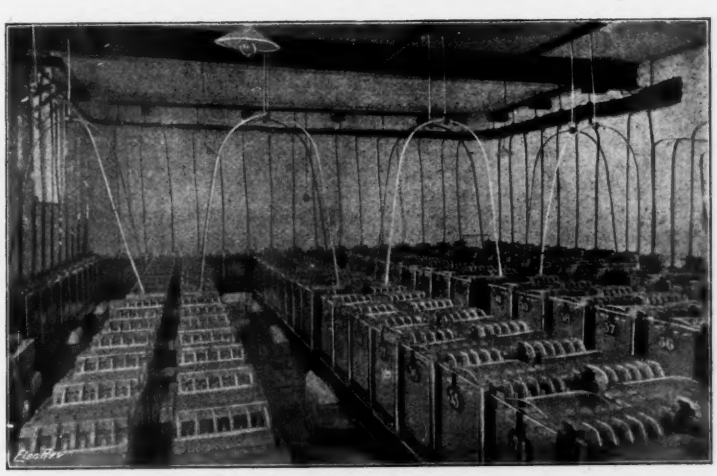
The main switchboard is fixed on a gallery at the end of the room, and consists of five enamelled slate panels, carried in wrought-iron frames. The centre panel carries the apparatus for controlling the balancer and booster, Crawley automatic battery switch, and various feeder and battery voltmeters, of Messrs. Nalder Bros. & Thompson's make. The adjacent panels carry the battery switches, with Messrs. Crompton & Co.'s special racking gear, while the outer panels are fitted with the switches and instruments for the positive and negative feeders and dynamos. The whole of the ammeters and voltmeters are of the permanent magnet moving coil type. Two Aron meters record the charge and discharge of the batteries, and Thomson meters are fixed in circuit with the dynamos, feeders, and station circuits; thus an accurate record can be kept of all losses between the dynamos and the consumers' meters. The regulating resistance switches for the dynamo fields are mounted on the railing of the gallery.



Heywood: Main Switchboard.

The connections behind the board have been kept as far as possible free from rubber insulation, so as to minimise the risk of fire.

The battery room contains 220 11-plate cells of the Marquand Accumulator Company's make, having a capacity of 350 ampere-hours. The plates are of the Planté type, with massive and rigid frames, and are designed so as to reduce to the utmost the possibility of buckling and short-circuiting.



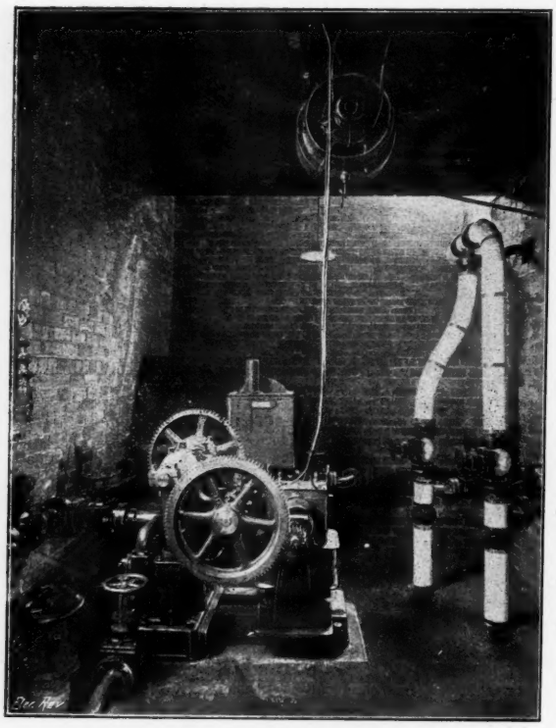
Heywood: Battery Room.

The cells are all on the same level, and are carried by

wooden beams, supported on brick piers with glazed porcelain tops. The regulating cells are arranged round the sides of the room, and the connections are made in a novel manner; the conductor, of flat copper strip, is carried up from each cell to the ceiling, and then round the sides of the room to the switchboard. Distance pieces of vulcanised fibre are inserted between the consecutive copper strips to keep them apart, and the whole bunch is suspended from porcelain insulators. This arrangement gives a neat appearance to the connections, as shown in our view, and takes up very little space behind the board.

Two milking boards are provided in the battery room, by means of which healthy cells can be coupled up to defective ones to bring them into good condition.

The mains and feeders in the town have been laid by the St. Helens Cable Company, Limited. At present two feeders are in use, and the distributing mains are being put in



Heywood: Pump Room.

wherever the probable demand justifies the outlay. Pilot wires are run back from the feeding points to the engine room, where they are connected with a special board.

The whole of the cables are lead-covered; some are insulated with bitumen, others with impregnated paper, and they are laid on the solid system in wooden troughs, which are filled up with bitumen, and covered with 2-in. tiles.

The supply was commenced on September 30th last, and the first building to be lighted was, appropriately enough, the municipal technical school. The formal opening ceremony took place on October 26th. At present there are about 34 consumers actually connected, with 2,000 8-c.p. lamps, and a number of motors. Further applications have already been received for both lighting and power, and the prospects before the installation are very favourable.

The consulting engineer for the whole of the work was Mr. W. P. Adams, to whom we are indebted for particulars and photographs of the undertaking.

Bray.—The U.D.C. has decided to instal sufficient plant to enable it to increase the receipts, by increasing the output of the works and the business of the department generally.

ELECTRIC MOTOR TESTING WITHOUT A DYNAMOMETER.*

The best-known method of testing an electric motor for efficiency is to put an artificial or frictional load on the machine by means of some form of brake dynamometer, measuring the mechanical torque in pound-feet delivered to the dynamometer and the electrical power in watts delivered to the motor from the supply circuit; multiplying the pound-feet by the revolutions per second and dividing by the watts gives the percentage of intake that the motor is able to convert into useful work. This method is simple enough, and if one has a reliable Prony brake and is experienced in the use of it, there is nothing more to be desired.

Central station superintendents who have not a sufficient amount of motor testing to do to justify the expense and application of a good brake dynamometer, and yet have occasion to test a motor now and then, will find the following method useful: (1) Connect the motor to a supply circuit of the proper voltage, or of a voltage a trifle higher than that at which the motor is rated, putting an adjustable resistance in series with the machine, and an ammeter in the armature circuit. Run the motor free, with all the starting-box resistance cut out, and adjust the auxiliary resistance until the voltage at the motor terminals is precisely the rated voltage of the machine; represent this by E. Then measure the armature current, and represent its value by c.

(2) Next, and immediately, stop the motor, secure the armature shaft so that it cannot turn, and connect the brushes to the circuit again through a resistance by means of which the armature current can be adjusted to the value, c, which it had when the armature was running free; then measure the volts at the brushes, and represent them by v. Subtract this voltage from the rated voltage E, and multiply the difference by c; the result will be the armature core and friction losses in watts, thus:—

$$(E - v)\, c = w,$$

and the resistance of the armature circuit may be taken as equal to

$$\frac{v}{c} = r,$$

without important error. In making the test just mentioned, care should be taken to prevent the armature current at any moment from exceeding the value, c, obtained running free.

Now, if the rated output of the motor, reduced to watts, be represented by W, the following formula will give the armature current at which this rated output will be obtained:

$$C = \frac{E - \sqrt{E^2 - 4\,(W + w)\,r}}{2\,r}. \qquad (1)$$

The efficiency of the machine, then, will obviously be

$$\frac{100\ W}{E\,(C + C_f)} = \text{per cent. efficiency.} \qquad (2)$$

Here C_f represents the current in the field winding at rated voltage, which can be readily measured.

Example:—A 220-volt motor rated at 10 H.P shows the following values: Armature current running free, 2·4 amperes; field current, 1·1 ampere; volts at the brushes, with armature stationary, $\frac{3}{4}$ volt. These figures give the following values to the symbol letters:—

$$E = 220;\ W = 7{,}460;\ c = 2{\cdot}4:\ v = 0{\cdot}75;$$
$$w = 510;\ r = 0{\cdot}3125;\ C_f = 1{\cdot}1.$$

Substituting in formula (1):

$$C = \frac{220 - \sqrt{48{,}400 - 4\,(7{,}460 + 510)\cdot 3125}}{\cdot 625} = 38{\cdot}31.$$

This is the full load armature current, and the efficiency according to formula (2) will be

$$\text{efficiency} = \frac{746{,}000}{220\,(38{\cdot}31 + 1{\cdot}1)} = 86 \text{ per cent.}$$

(and a trifle over, the accurate figure being 86·037).

* *American Electrician.*

Formula (1) may be reduced to a somewhat better expression so far as the actual work of computation is concerned, thus :—

$$C = \frac{E}{r} \times \left(0{\cdot}5 - \sqrt{0{\cdot}25 - \frac{r\,(W + w)}{E^2}}\right).$$

The formulæ for full load current are based upon the assumption that the core losses, armature, friction, windage and pole-piece eddy-current losses all remain constant from no load to full load. While this is not strictly true, the error introduced is practically negligible.

FACTORY LAW.

Of all the subjects which are dealt with in our tangled system of jurisprudence there is none more important and none which has been hitherto so unmethodically dealt with as the law relating to factories. Text-book writers have attempted to draw up a code which may be understood to some extent by the uninitiated, but even a lawyer sometimes gets lost when trying to find his way about in the Factory Acts. The need for reform is all the more pressing because of the new industries which are springing up every day to which old rules are inapplicable.

The Factory and Workshop Act, 1901, is a laudable attempt on the part of the Government to reduce chaos to order. As the measure does not come into force until January 1st, 1902, we do not propose to deal with it in these columns at present.

The more prominent points which require elucidation in connection with the Factory Acts, and which have not been rendered any clearer by the new Act, are well illustrated by reference to a few cases which have recently come before the Courts for decision. If any further argument was needed to show the necessity for factory legislation, we might point to the law reports, in which during the present year cases relating to factories have been more than usually frequent.

A primary difficulty seems to arise in connection with the definition of the word "factory." Two cases will illustrate how diverse are the opinions of the Court upon this point. In Law *v.* Graham [17 *Times* Law Reports, 474] the question arose whether premises upon which bottles are washed by mechanical power, and then filled with beer by manual labour alone, are a "factory" within the meaning of Sec. 93 of the Factory Acts, 1878, now reproduced in Sec. 149 of the F. & W. Act, 1901. It was argued that inasmuch as the washing was not part of the manufacturing process, it could not be said that mechanical power was used upon the premises for any purpose of manufacture. The Lord Chief Justice adopted this reasoning. He said: "I think mechanical labour exercised in washing the bottles is not incidental to adapting the beer for sale." The Scotch lawyers appear to have taken a different view. In the case of Petrie *v.* Weir (2 F. 1,041) it was decided that stone-dressing works, where the stone-dressing was done by hand, but where a gas engine was used for sharpening the workmen's tools, were a factory within the meaning of the Act. These extraordinary conflicts of opinion arise from the distinction which must necessarily be drawn between premises which are, and premises which are not, for the manufacture of produce by machinery.

It is hardly necessary to point out to those who have been affected by the Workmen's Compensation Act, that that measure has rendered the correct definition of a "factory" all the more important. In one case the question arose whether a farmer is the owner of a factory, and as such, liable to make compensation to his labourers for injuries sustained by them when he has a movable steam engine and mill to grind meal for the use of his stock. The Court decided that this was not so, for the following reasons, any one of which would seem to have been sufficient:—(*a*) he was not making any article; (*b*) he was not finishing or adapting any article for sale; (*c*) he was not doing it directly for purposes of gain, but only indirectly for the benefit of his own cattle. [Nash *v.* Hollinshead, 17 T.L.R., 352.]

In matters relating to the sanitary condition of a factory, a case of recent date seems to indicate that the inspectors are vested with somewhat arbitrary powers. Thus it was decided in Tracey *v.* Pretty [1901, 1 Q.B., 444], that justices have no jurisdiction to hear evidence upon, or determine, the question of suitability or sufficiency of sanitary accommodation existing in a factory, or required by the notice served by a factory inspector upon the owner; the requirements of the factory inspector must be carried out, subject, however, to an appeal to Quarter Sessions under Sec. 7 of the Public Health Acts' Amendment Act, 1890. As an appeal of this kind involves trouble and expense, it is probable that manufacturers will be content to obey the imperious mandate of the factory inspector. With regard to ventilation and sanitary efficiency, it is not necessary for the inspector to show that injury was actually caused to any person or persons before he can institute proceedings for the enforcement of an order made by him under the Factory Act. Thus in a case which came before the Divisional Court, the inspector sought to enforce an order made by him to the effect that the owner of a mill should provide a fan or other means of ventilation in a factory where a process was carried on which as he alleged, caused dust to be generated to an injurious extent. It was decided that actual proof of injury to any of the workmen was not necessary to support the validity of an order of this kind. This construction seems to be in accordance with the spirit of the Act, because if it were necessary to prove an actual injury, many workers would be deprived of the safeguard to their health which the legislature clearly intended to give them. [See Hoare *v.* Ritchie (1901) 1 Q.B. 434.]

There is no set of provisions in the Factory Acts more rigidly enforced than those which have been prescribed in the Acts to protect workers from risk of injury by fire. It is obvious that in a crowded district, where a "factory" within the meaning of the Act forms part of a building or group of buildings, the owner of the factory must often be compelled to enter into some amicable arrangement with his neighbours in order to provide a suitable fire-escape. Thus, suppose the factory occupies the whole top floor of a building. The inspector says that the existing staircase is not sufficient, and makes an order to compel the erection of a second staircase through a portion of the building which is occupied by another tenant. In these circumstances must the factory owner obtain the necessary consent at compulsory purchase prices, or, in the alternative, run the risk of an action of trespass? It is now settled by the case of the London County Council *v.* Brass [17 *Times* Law Reports, 504], that a notice under Sec. 7 (2) of the Factory and Workshop Act, 1891, (now reproduced in Sec. 14 of the F. & W. Act, 1901), is not a final and binding order on the owner to do an act which would constitute a trespass on his neighbour's property, and the owner could not be convicted for disobedience to the notice merely because he had not taken the Council to arbitration.

Cases under the Truck Acts are also of general interest to those who have occasion to deal with the rougher classes of artisan. The principle that a workman shall not be paid in anything but hard cash is sound enough from the workman's point of view, but it is expedient that an employer should, for some purposes, be able to have recourse to fines, and that he should be allowed to exact those fines by stoppage of wages. We are glad to find that the Court has approved a decision of the magistrates who held a fine lawful which was imposed for breach of a rule of "decorum" in a factory. Not that an ordinary factory is a place where the standard of decorum need necessarily be high, but because, in our view, an employer of labour should be at liberty to make reasonable provision for the orderly conduct of his business.

A COUNTY COUNCIL SPECIFICATION.

We have during the past week been much interested in reading a specification recently issued by the London County Council. The articles required simply consisted of a year's supply of the engineer's sundries, such as bolts, nuts, washers, pipes, and electrical sundries required for the various establishments under the Council's control; but the conditions of contract to which the tenderer had to subscribe his name were of such a character, that the protection was all on the side of the purchaser, and the risk on the side of the would-be contractor.

For instance, in the first paragraph the tenderer must declare that he pays rates of wages, and observe hours of labour, *recognised by the trades unions of the district in which the work is done as fair.* Not one word as to joint recognition by employers' associations as well as trades unions, but just the payment of what are termed trade union rates.

Again, while the tenderer pledges that he will supply during the specified period the goods tendered for at the prices named; the Council is not to be bound to purchase either the amount named, or to purchase all its requirements from the selected contractor.

It may, if it think fit, purchase from other firms, and presumably invite other firms to re-tender for the goods during the continuance of the contract. This does not seem fair; in a large contract it would be strenuously opposed, and we are doing nothing less than our duty in exposing it here. Again, while the tenderer must abide by his offer, the contract may be determined summarily by the Council at any time in the event of a breach of those conditions by the contractor, or *at any time by giving* 14 *days' notice in writing.* This is unfair; the contract should be equally binding on both sides, and not only on the unhappy contractor. Goods rejected by the Council's inspector are to be at once removed by the contractor at his expense and replaced *within seven days*, apparently whether procurable in that period or not.

Finally, there is no means of appeal from the arbitrary action of any of the Council's officials, and here, we think, another injustice is being done. The sum at issue may be small, but an injustice perpetrated upon even the small contractor is an injustice still, and it is only right that some means of appeal should be open to all who have dealings with the Council, whatever the amount at issue.

We cannot help again expressing our opinion that the London County Council perpetrates an injustice upon all its constituents, workers as well as employers, in thus endeavouring to make use of its position to force such one-sided regulations upon the small tradesmen with whom it has business relations. The conditions attached to its larger contracts are becoming of a more reasonable character; justice demands that similar concessions should be inserted in the minor contracts entered into from time to time.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Contractors" write:—"Can a metropolitan borough council having a central supply station legally undertake wiring contracts in competition with outside firms?"

*** The question put by "Contractors" has frequently been discussed in this column, but in view of its importance we are glad to have an opportunity of putting forward our view upon the subject. There is nothing in the Electric Lighting Acts, 1882—1889, to prevent a borough council undertaking wiring contracts, but the recognised rule of law is that a corporation has no power to do anything which is not expressly provided for in its charter or private Act. In the absence of any reference to the statutory powers of the metropolitan borough council referred to by our correspondent, it is difficult for us to give a final opinion. We are not aware of any private Act which expressly gives these powers.

The following case supports the view above expressed:—

In Leicester Corporation *v.* Hill [The Electrical Review, April, 1898], the plaintiff sought to recover in the County Court for electric light fittings supplied by them. His Honour, in the course of his judgment, said:—"I can see nothing in the Electric Lighting Acts of 1882—1888, to authorise the Corporation to supply any fittings except meters. . . . . Much reliance was placed upon a form of account sent down by the Board of Trade, and it certainly appears from that form that the person who drew it up contemplated that the Corporation would buy and sell lamps and other apparatus. . . . . I am of opinion, however, that a mere indication by a Government department that in its judgment a thing may be properly done, cannot have the effect of authorising that which otherwise would be contrary to law. Sec. 9 gives the Board of Trade no power to authorise anything at all, but merely to prescribe the form of accounts."

THE UNDERGROUND RAILWAY ELECTRICAL INQUIRY.

(*Continued from page* 710.)

On Wednesday last week the Arbitrator again set in the Lord Chief Justice's Room, when Mr. R. W. Perks, M.P., continued his evidence, and said that from the very beginning of the negotiations he told Mr. Forbes that he would not consent to any of the District Company's money being spent on an untried system such as the Ganz. He also made the same statement at a meeting he had at the Charing Cross Hotel with Mr. Forbes and Col. Mellor (the deputy chairman of the Metropolitan Railway).

Mr. C. T. Yerkes described the different railway and tramway systems which he had been interested in in America, but said his interest had always been that of a capitalist and not as that of an engineer. He had never been interested pecuniarily in any one system, his object always being to get the best. He had considered the question of changing the locomotive system on the Underground Railway for years, but in 1896 he gave up the idea of getting an interest in the lines. Afterwards, at the solicitation of Mr. Perks, he looked further into the matter, and he made up his mind that it was a good time to step in and put new life into the concern. In America practically only the direct system was employed. As the result of his second inquiry he proposed to find the money to convert the two railway systems to electricity on the terms of the Traction Company's contract, and £1,000,000 was subscribed before the company was formed. His company had not the slightest pecuniary interest in the adoption of one system rather than another except its reliability in working. One gentleman, however, who had subscribed was Mr. Coffin, who was president of the General Electric Company, which was a manufacturing company. The General Electric Company would have no interest in one system being adopted rather than another, for they manufactured both the alternate system and the Ganz system. He did not pretend to be an electrician, but he would be a foolish business man to go into the realm of experiment in that matter and spend £1,000,000. They had tried what he might call the "General" system, and had found it acted perfectly.

Mr. E. W. Rice, electrical engineer, and one of the vice-presidents of the General Electric Company, of America, described the direct current system of traction generally adopted on tramways and overhead railways. With regard to induction motors, they had been known for 12 or 14 years, and they had made experiments over 10 years to see if they could be used on railways for operating cars, and they had not found them suitable for such conditions as existed on the Metropolitan Railway. They were much attracted by what appeared to be the simplicity of the induction motor as opposed to the direct current, and the tests were made with the direct object of seeing their value for tramway purposes. They came to the conclusion that as to the cost of both installation and running, the direct current gave better results. A tri-phase induction motor was only payable at all where they had long runs at a uniform speed. In the Inner Circle the conditions were diametrically opposed to what were suitable conditions for tri-phase induction motors. There was no system of control worked out, such as the series-parallel system. He thought the meter-end resistance proposed by Messrs. Ganz was absurd for such a railway. From beginning to end he would condemn Messrs. Ganz's system most heartily for such a line as the Metropolitan. He believed it was intended to take the current from a trolley with a roller upon it, but he had never known that adopted except in experimental work. Many experiments were made in trolleys, but the one now almost universally used was practically the only satisfactory one. He would consider that the use of such a trolley as that contemplated would be very unsafe, and he thought such a high tension itself would be unsafe in such a tunnel. The rotary converter was one of the simplest contrivances ever invented, and its behaviour under both use and misuse left nothing to be desired. As far as he knew his company had no interest in the Traction Company, but if it had it would make no difference in the choice between the tri-phase and the direct system.

Cross-examined by Mr. Wallace, K.C. (for the Metropolitan Railway), Witness said the Boston Underground Railway was the only underground railway in America. Personally, he had a great deal to do with the Central London Railway, and they built the engines. The engines were a success except in two instances, and in both these instances the engineers acted contrary to his advice. It was true that the Central London Railway were trying the multiple control trains which were supplied by his company, but it was still direct current. He did not consider, however, that that was experimental. His principal objection to the three-phase motors was where there was a varying speed, but there were other objections. One was the idle currents carried. There was no doubt, however, that in many cases three-phase motors were as desirable as continuous current motors.

Re-examined by Mr. Fletcher Moulton: He did not know of a single electrical difficulty which had occurred on the Central London Railway. The multiple control system was not experimental in the same sense as the Ganz system; it had been used for some years. They were now being used on the Central London Railway, and, he believed, very successfully.

By the Arbitrator: He had objected to the use of induction motors generally, but he thought the difficulties connected with them would be more serious in underground than overhead railways. He was surprised to learn that men had been killed with 500-volt currents on the Central London Railway.

Mr. J. Swinburne, consulting engineer, said he had given much attention to electrical questions for 20 years. He had studied direct, alternating, and multiphase work. The direct current for 500 to 600 volts with series-parallel control was the system which had given the most general satisfaction. In the system such as adopted on the Central London Railway there was practically no danger to anyone. From the point of view of safety the low tension direct system was of great importance; from the point of view of energy, the rotary converter was economic. The use of continuous alternating current under the same circumstances would be productive of danger. The wires in the tunnels must be bare in order to allow a collection. There were various dangers connected with the wires. It would not take much contact with a wire carrying 3,000 volts to kill a man, and there was great danger from the trolley wires coming down. These wires were quite thin, and there was a tremendous wear and tear of them by the use of the rollers. To do any repairs they would have to shut up a section. In the case of junctions there would have to be additional guards. He had considered the system of motor proposed to be used by Mr. Ganz. The motor had been known for about 13 years, but with the exception of a few small lines it had not been used for traction purposes. He considered the motor was entirely unsuitable for use on the Metropolitan Railway. Mr. Swinburne then proceeded to describe the proposed system of Messrs. Ganz. The resistances were clearly described as waste, and he did not think the whole device for pulling up was practicable. The system of control suggested by Messrs. Ganz was perfectly untried, and he did not think could be practicable. Under the system each engine would have a particular speed, which it could not vary. For instance, if a train left Baker Street for Aylesbury and there was a wish to double the speed, they would have to double the voltage.

After the adjournment for luncheon, Mr. E. Moon raised the question as to the right of the Great Western Railway Company to intervene in the inquiry. He thought it would be permissible for the G.W.R. Company to say which of the two systems they preferred, although he admitted they would have no right to suggest a third sytem.

The Arbitrator said if Mr. Moon was to be permitted to interfere, all he could say was which system he was in favour of, and he suggested that as Mr. Moon must ally himself with either Mr. Fletcher Moulton or Mr. Cripps, it would be well to have the interests of the G.W.R. in the hands of either of those gentlemen.

Mr. Moon said neither of his learned friends would call his witness. Between Edgware Road and Aldgate, out of 278 trains run, the G.W.R. ran 208, so that their interest was as great as that of the District Company.

The Arbitrator thought that the G.W.R. Company out to have raised the question before the Parliamentary Committee; and after some further discussion, he ruled that he had no power to admit the G.W.R. as a party.

Mr. Yerkes again went in the box to be cross-examined by Mr. Cripps (for the Metropolitan Railway). He said that he was chairman of the Traction Company, and had a large interest in it. Practically, he negotiated the contract of the Traction Company with the Metropolitan District Railway. He had never stated to the managing director of Ganz's that he thought the Ganz system was satisfactory.

He told Ganz's people that if they had the best and the cheapest, he would take their system, but before he had examined much, he felt that he had come to Buda-Pesth on a wild goose chase. Three engineers went with him to Buda-Pesth, and they were all convinced that Ganz's system was no good.

Mr. SWINBURNE's examination was then proceeded with, and said he had examined the actual tender of Messrs. Ganz, and that of the British Thomson-Houston Company. He found that with regard to boilers the tenders were for different things.

The Court adjourned till Thursday.

The proceedings were resumed on Thursday last week, when Mr. SWINBURNE resumed his evidence, and in further answering Mr. FLETCHER MOULTON, said he knew of no case where wires containing such a voltage as that proposed by Messrs. Ganz were permitted by the Board of Trade where the public had access. Supposing they used continuous current of 3,000 volts, it would be in a very different position to that of Ganz's; they would have one overhead wire instead of two to collect from; they would not have the difficulty of the reversal of the motors on triangular pieces of line; and altogether it would be very much easier. It was easier to manipulate the direct current than the alternating. Proceeding to deal with Messrs. Ganz's letter to the Joint Committee in support of their system, witness said the statement that a single generating station was sufficient to work the whole circle was equally true of the direct station. It would be impossible to leave the sub-stations on the Ganz system without skilled attendance. With regard to the cost, the only difference was in the rotary converters and the motors. The motors were heavier on the one hand, and the rotary converters were saved on the other. But in addition, in Ganz's system, owing to the idle current wanted for the induction motors, the cables were heavier right through, and the generating station was a little bigger. On the whole, he thought the cost would be against the alternating current. With regard to control, Ganz's system was so nebulous, that he did not know what the details were. So far as he could see, it was not right to say the high tension was an advantage of the alternating system, but it was an unavoidable difficulty.

Cross-examined by Mr. CRIPPS: In the continuous current of 550 volts the pressure would be carried on rails at the same level as the running rails. Those rails must be exposed; they must be absolutely bare. Those rails would be accessible to anyone. He did not think anyone coming into contact with the rails would be killed—it would make him jump; 500 volts would not kill a man instantaneously. It would never do to allow 3,000 volts in the same position. A proposal of the District Railway was to have the two conducting rails put on the platform side, but he did not think that would be more dangerous than putting it on the other side of the rails. It was claimed that the overhead conductor of the three-phase system was placed in such a position that no one could get in contact with it, and that would be an advantage if they put aside the question of voltage. He contended that there was difficulty in putting such wires out of danger in such a tunnel as that proposed. He might be able to overcome the difficulty if he tackled the subject.

Mr. CRIPPS: Does the question come to this—Whether the supporters of the polyphase system are able, in their view, to put up this overhead conductor so that no human being can come into contact with it?—That is the question.

And if it can be so done, their system would be safer than the continuous current system, although the pressure is higher?—Their system, if protected, would be safer if the same means were not applicable to the direct current. The supporters of the direct current can use the same ingenuity and have not such a dangerous thing to protect.

Mr. CRIPPS proceeded to cross-examine witness on the question of the liability of breakdown. WITNESS said he took the high pressure as a part of the alternating system, and there would be a greater danger from breakdowns owing to the trolley wires breaking down. He thought also that the control system was likely to go wrong.

Mr. CRIPPS: Speaking as an electrician, there is no reason why there should be more breakdowns in one case than in the other?—Not with equal experience in each case. There is no inherent cussedness in the alternating current at all.

Further cross-examined, WITNESS said that in substance they could get the same acceleration with the same power under the same circumstances, but they could get a larger margin of speed with the direct current. A given speed for a continuous run could be got with either system. Under the alternating system they could build a motor to go at 25 miles, and it was fixed at that speed, but in the case of direct current if they built a motor for a speed of 25 miles they could work up to 30 miles with the same motor with high efficiency. With regard to long distances, it was an advantage to have high pressure and small conductors.

The ARBITRATOR: I thought that your point yesterday was that a motor applicable for the Inner Circle would be inapplicable for working on the Outer Circle?—Yes; my point was that a 25-mile motor was a 25-mile motor, and you can't make it 50.

Mr. CRIPPS: Of course you can't; but if you want for your outside system a higher pace than 25 miles, that is only a question of constructing your motor in order to get that pace?—It means changing engines.

But apart from that there is no inherent difficulty in getting alternating motors to get up to whatever speed you require for the outside?—There is no difficulty in making 50-mile motors and running them over the Inner Circle, but it would be inefficient running at 25 miles.

Cross-examined on the question of cost, WITNESS said they would want the same generating station in either case, and they would have the same expense in bringing the current to the sub-stations, subject to the cost of the larger cables in view of the power factor. The rotary converter was not necessary in the alternating station. If accumulators were used in the direct system they would not want such a large central station. Broadly speaking, he thought it would be found that Ganz's system would be a little more expensive than the other. He did not go so far as to affirm that it was impossible to make an alternating current of 3,000 volts safe, but he could not modify his opinion that it was highly dangerous.

An apparatus was produced showing what was proposed for safety in the Ganz system if the wire broke, and WITNESS said that while he had a constitutional objection to such devices, it would, no doubt, greatly minimise the danger if it acted all right. In connection with the motor, he took objection to the liquid rheostat. He could not admit that a liquid rheostat was the best. He look upon it quite as an experiment, although it might possibly be an advance on the rheostat used without continuous current motors.

In re-examination, WITNESS said there was no difficulty in making high tension continuous motors. With regard to safety appliances, only experience could tell whether they could be adequate. Accidents arose sometimes from automatic safety devices.

Mr. YERKES was recalled with regard to some telegrams he received from Mr. Chapman as to his opinion on Ganz's system.

The Court adjourned till Friday.

On resuming on 1st inst., Mr. T. RUSSELL CHAPMAN went into the witness chair. Replying to Mr. FLETCHER MOULTON, WITNESS said he had had 26 years' experience in the installation of electric railways, and had constructed several lines in the United States, particularly in Chicago. He had also had experience in converting systems from steam to electric traction. In all of the systems with which he had been connected, the direct current had been used. There was no electrical difficulty in working railways by the low tension direct system, nor would there be in working the Inner Circle by the system. He had used a series parallel control on all the systems with which he had had anything to do. By that system of control locomotives or motor cars could be worked. He had acted as engineer to Mr. Yerkes, but had no interest in the tenders which had been submitted. There was no system which could be utilised for the conversion of a line from steam to electricity, so safely or so economically, as the direct-current system. He had examined the Ganz and the British Thomson-Houston tenders, and considered that the latter related to a first-class plant. Witness then detailed his objections to the Ganz system, and said the class of condenser was not compatible with best modern practice. Such a system as the Underground Railway would require independent condensers, and in that respect the Thomson-Houston system provided an ample margin of safety. He considered there was no room for the proposed rollers at the top of the tunnels of the Underground Railway.

Mr. WALLACE said they intended to change the trolley somewhat.

Continuing, WITNESS said that, in his opinion, the contact arrangements proposed would not work on a line like the Inner Circle. The proposed method of suspending the wires in the tunnels would not work, and, until proved, he should consider the device suggested for catching a falling wire a dangerous expedient.

Mr. WALLACE pointed out that span wires were not to be used.

WITNESS, continuing, said that a rigid support was more liable to breakdown than an elastic support; with a wheel trolley and a train service of one a minute, the trolley line would last about a year and a half, but a sliding trolley would not last half as long. Regarding the proposed motors, he did not consider they could be worked in practice.

Cross-examined by Mr. CRIPPS, WITNESS said it was correct to say that they would want rotary machines for transforming the current. The actual cost of that machinery would come to £45,000. It was assumed that the Inner Circle would have an all-night service at frequent intervals. For that purpose accumulators would be necessary, and a half-hourly service throughout the night would entail an expenditure of about £7,500 on accumulators. He gave 50 minutes as the time a train would take to run round the circle. That would include 27 stops of 20 seconds each. Witness spoke to a visit he had paid to Sondrio, where he had examined the working of the Ganz system, and said, in his opinion, the power of acceleration obtained would be quite insufficient; in fact, altogether hopeless on the Inner Circle so far as getting 16 miles an hour. Questioned as to whether the system was capable of producing light for the carriages, Mr. Chapman said he did not think it was, but by the direct system not only could they produce light but also heat for the trains.

Some argument took place between counsel as to the relative cost of the two systems, Mr. CRIPPS maintaining that the balance of cost would be enormously in favour of the Ganz.

The ARBITRATOR said he feared that it was not prudent to go into the question at that stage.

Mr. CRIPPS said that when he came to open his case, he thought he would be able to bear out his contention.

Replying to the ARBITRATOR, Mr. FLETCHER MOULTON said he believed that both parties had had four months to prepare their tenders.

On resuming on Saturday, Mr. CHAPMAN'S cross-examination was continued. He maintained that it was impossible for the plant specified in the Ganz tender to give more power than that specified in the Thomson-Houston tender, because it had considerably less boiler power.

Mr. CRIPPS: I want to know whether from your knowledge as an electrician, you are not perfectly well aware that whether you have one system or another, there is not the slightest difference on this question of acceleration?

WITNESS said he could only give as an answer the fact that with the direct current it had been done every day on hundreds of miles of railway, but it had never yet been done with the alternating motor, and it was a question if it ever could be done by that system at a reasonable expenditure.

But cannot it be done equally well with one system as by another?—No, it cannot.

The ARBITRATOR: You have mentioned the immunity from accident which you have had in your system in America. Do you put any protection to the charged rail there?

WITNESS: On the old road, which was converted from steam to electricity, it was necessary to put a board on one side of the railway, because the base of the rail came within 2 in. of the ironwork of the structure, and in order to protect that rail a piece of board was used; but on the newer lines, where the structure was designed for the use of the electric rail, no board was used, the rail was unprotected.

Do you attribute the safety which you have experienced to the charged rail being comparatively harmless, or to its being inaccessible to the public, or both?—Of course, our only risk with a third rail on an elevated structure is some trespasser getting off station platforms on to the permanent way, or to a member of the staff doing some careless act, which they should not do. The particular danger in any of these surface contact roads lies in the carelessness of the staff, and it is to them alone that the accidents would occur if it ever occurred.

With that one exception, you have never had any protection?—No.

Mr. PHILIP DAWSON, in reply to Mr. MOULTON, said that he was chief engineer to Messrs. Robert W. Blackwell & Co., engineers and contractors, of London, with branches in New York, Milan, &c. He had carried out a large portion of the electric traction work of the kingdom as well as in the Colonies and on the Continent. He had built or equipped over 1,000 miles of electrical tramways. He had no connection with or interest in any particular form of traction. He had inspected and was familiar with the three-phase traction systems that were actually working, and had visited all the important three-phase traction systems.

What kind of railways are they?—They are entirely used for taking people to see sights. They are practically used in excursion roads; many of them are only run in the summer.

WITNESS then described the system which was working on the Burgdorf-Thun line in Switzerland, and said that such a railway as that was not at all comparable with the Metropolitan Railway. The direct-current system, would, in his opinion, be capable of dealing with the Inner Circle. As a matter of fact, it was a system which had been applied underground as well as overhead with success. The three-phase motors were particularly bad for very rapid acceleration. He had inspected the proposed method of suspension of the Ganz wire and also the safety device, and disapproved of them. He had put up an enormous amount of trolley wire—probably 80 per cent. of all the overhead trolley wire in the United Kingdom had been put up by him, and his experience had taught him that rigid suspension was not the right mode of working. Rigid suspenders were first put in when electric traction was started in England some seven years ago. It was thought that that system would do, because at that time the cars were not allowed to go at a higher speed than eight miles per hour, but they had to take them all down and replace them with flexible suspenders, because of the damage and delay caused by the frequent breakages. They found that at the point where the trolley struck the rigid wires there was a spark emitted which made a small dent in the copper wire and rendered it very liable to break. He should say it would not be safe to instal a high tension or any wire in the way proposed in the tunnels of the underground railway.

Mr. MOULTON: Do you think it would be absolutely unsafe?—Yes, and I consider it would be very dangerous. The wires would be continually breaking, and the repairing of them would cause very serious inconvenience and interruption of the traffic. In the event of a break the current would have to be entirely shut off at either end of the section where the break occurred before any repairs could be ventured upon, and that, of course, would take some time.

About what time do you think it would take?—It depends upon the seriousness of the work—it might take hours. Supposing a wire were broken and there was a train in the way, you would have to get your appliances on the other track and block the up line as well, and keep the current off until the repairs were finished.

Speaking as a practical man, do you think that overhead wires like this of high tension current ought to be permitted?—I do not. Continuing, witness said he considered it would be very difficult, if possible, to work a railway with junctions like the Metropolitan on the three-phase system. He had built several thousands of trolleys for tramway purposes, and with his experience he was very sceptical as to the practical working of the underground railways of such trolleys as he saw at Sondrio.

In cross-examination, WITNESS said that as regarded control, the driver of a continuous-current motor could use the motor as a very powerful additional brake.

Mr. G. E. HALL, the engineer and locomotive superintendent of the District Railway Company, gave evidence with regard to the experimental electrical train which the company ran at Earl's Court. He said he was responsible for the safe working of the line, and even long before those experiments he had been of opinion that overhead wires were inadvisable for the purposes of their railway. He always regarded overhead wires as giving a large amount of trouble in the way of repairing and maintenance, and they always occasioned an engineer great anxiety owing to the risk of accidents.

Mr. MOULTON intimated that this closed his case.

The inquiry was continued on Tuesday and Wednesday, and was then adjourned to Monday next.

THE OPENING OF HACKNEY ELECTRICITY AND DUST DESTRUCTOR WORKS.

ON Thursday last week a large company of about 1,500 of the principal residents in the Hackney borough assembled at the new electricity works at Millfields Road, down by the River Lea, to witness the switching on of the light by the Mayor (Mr. W. R Horncastle). The proceedings were under the chairmanship of Mr. Alderman Richmond, the chairman of the Electric Light Committee. We need not enter into details as to the speeches which were delivered, beyond mentioning that the chairman trenched somewhat on the ground which was allotted to Mr. Hammond on the programme. Mr. Hammond, in the capacity of consulting engineer, explained the scheme and the objects of the lighting and destructor sides of the installation in his own popular and acceptable manner. There was a good deal of story-telling by one and another, and this led the worthy Mayor of Hackney to think it necessary to preface what he had to say with the remark that it was truth. He proceeded to refer to the very large street mileage of the borough, afterwards switching on the light for the public streets and private supply, and also to two bronze electric light standards which were intended as presents for himself and Alderman Richmond, respectively.

The company subsequently went for a tour through the different departments of the works, and partook of light refreshments by way of preparation for the celebration banquet, which was held at the Hotel Cecil in the evening. Mr. Hammond presided at the banquet which was given by the engineer, architects and contractors, and he was supported by the Mayor and Mr. T. H. Robertson, M.P.

"Success to the Undertaking" was proposed by Mr. Lewis Coward, K.C., and acknowledged by Alderman Richmond. The toast "The Consulting Engineer and Architects" was responded to by the chairman and Mr. Gordon, of Gordon & Gunton. "The Contractors" was proposed by Mr. J. W. Whiter, and responded to by Mr. S. Z. de Ferranti (for the B.I.W. Company), Mr. Leonard Holmes, Mr. John Greenwood, the builder, and Mr. H. E. Hughes, of Hughes and Stirling, who supplied the destructor plant. Other toasts followed.

We shall have an opportunity of describing the undertaking in detail when the works are more complete. At present a brief outline description will suffice. We gathered from Alderman Richmond's remarks that the dust destructor will not be in working until early spring. Then there will be sufficient steam raised by the destructor to run one of the small sets (300 KW.), so that in the main coal fuel will be employed.

The system is a low pressure continuous current direct (three-wire) supply with 240 volts at consumers' terminals. For motive power the pressure will be 480 volts. The capital cost of the complete scheme of electricity supply and refuse destruction as at present devised will amount to £285,000, including cost of the land.

The refuse destructor consists of 12 furnace cells, capable of burning 160 tons of refuse in 24 hours. Arrangements have been made for the automatic handling of the refuse, so far as this is possible, from the moment it is tipped at the works to the time when it emerges from the furnaces in the form of clinker. The destructor part of the works is not yet complete.

The site allows for ample means of extension of the works, and has a frontage to the Lea River. On the river a lay-bye has been constructed in order to provide economical facilities for the supply of fuel and the shipment of the clinker material.

The present buildings will afford accommodation for 6,000 H.P. of plant. Sufficient land has, however, been acquired to permit of a further 6,000 H.P. being added by an extension of the buildings.

The contractors were as follows:—

Electricity supply mains	British Insulated Wire Co., Ltd., Prescot.
Engine house plant—	
Two 800-KW. generators ..	J. H. Holmes & Co., Newcastle-on-Tyne.
Two 600-KW. generators ..	
Sub-Contractors.—	
Two 500-H.P. engines	Willans & Robinson, Rugby.
Two 1,000-H.P. engines ..	Belliss & Morcom, Birmingham.
Refuse destructor	Hughes & Stirling, London, W.C.
Sub-Contractors.—	
Boilers and superheaters ..	Babcock & Wilcox, Limited, Glasgow.
Ironwork	J. Buchanan & Son, Liverpool.
Economiser	E. Green & Son, Limited, Wakefield.
Accumulators	Tudor Accumulator Co., Limited, London
Arc lamp pillars	W. T. Allen & Co., London.
Buildings	John Greenwood, London.
Sub-Contractors.—	
Constructional ironwork ..	Dorman, Long & Co, Middlesbrough.
Condensing plant	Cole, Marchent & Morley, Ltd., Bradford.
Water cooling plant	Klein Engineering Co., Ltd., Manchester.
Pipework and valves	Aiton & Co., Willesden Junction, N.W.
Feed Pumps	Worthington Pumping Engine Co., London.
Switchboard	Ferranti, Ltd., Hollinwood, Lancashire.
Testing instruments and boosters	Johnson & Phillips, Old Charlton, Kent.
Public arc lamps	Johnson & Phillips, Old Charlton, Kent.
House meters	Chamberlain & Hookham, Ltd., Birmingham.
Overhead crane	Higginbottom & Mannock, Manchester.
Workshop equipment	Easterbrook, Allcard & Co., Ltd., Sheffield.
Wharf wall and lay-bye	Thos. W. Pedrette, Rochester.
Mechanical coaling apparatus ..	Mirrlees, Watson & Co., Ltd., Glasgow.
Works wiring and power circuits	Marryatt & Place, London, E.C.

A commodious coal store equipped with coal-conveying apparatus will be erected alongside the boiler house. A lay-bye and wharf has been constructed by the Council on the River Lea, and the coal will be taken direct from the barges by an electric crane and delivered to the conveyer through an automatic weighing machine and from thence into the stores.

There are six Babcock water-tube boilers, three of which are arranged to utilise the heat of the refuse destructor gases. The others are placed in the permanent boiler house, and are equipped

with mechanical chain grate stokers, water purifiers and superheaters.

A surface condenser has been provided for each pair of engines, each condenser being equipped with three-throw motor-driven air and circulating pumps. As there were difficulties in the way of taking water from the Lea navigation, a cooling tower has been erected in connection with the condensing plant, so as to economise the circulating water as much as possible.

There are two feed pumps, two steam-driven and two driven by electric motors, all of which were supplied by the Worthington Pumping Engine Company.

The Electric Generating Plant.—The four sets of generating plant erected in the engine house, amounting to 3,000 H.P., are sufficient, with the accumulators, to supply electric current for about 75,000 8-C.P. lamps connected to the mains, after allowing for an ample amount of reserve plant.

The electric generators consist of direct current dynamos driven by engines of the triple-expansion high speed type, two being of 1,000 H.P., or 600 KW., and two of 500 H.P., or 300 KW. capacity. The two 1,000-H.P. engines are by Belliss, and the 500-H.P. engines by Willans & Robinson, the dynamos being supplied by Messrs. J. H. Holmes & Co.

The operations connected with switching and recording of the currents are controlled from the switchboard fixed in a central switch gallery in the engine house, the generator panels being at the front and the feeder panels at the back of the board.

A battery of Tudor accumulators, having a capacity of 2,800 ampere-hours, will store for future use the energy developed in the refuse destructor at times when it would otherwise be wasted.

The supply mains are of the B.I.W. Company's triple-concentric type throughout, insulated with paper and covered with lead. They are laid in stoneware and iron troughs, filled in solid with a bituminous compound.

For the public street lighting 320 arc lamps have been provided by Messrs. Johnson & Phillips, of the "Ark" type. The charge for private lighting is 4d. per unit, and for motive power 2d. per unit. Special facilities for "free wiring" are provided under an agreement with the National Free Wiring Company.

Mr. L. L. Robinson is the borough electrical engineer at Hackney.

CORRESPONDENCE.

Multiplicity of Tenders.

We are very glad indeed to see that you have begun a criticism of the present practice of asking for tenders on engines and dynamos combined, and we heartily approve of what you have said on the subject.

It seems to us clearly a matter for the consulting engineers, or those asking for tenders, to rectify; because, if combined tenders are called for, an engine builder is bound to offer his engines with several dynamos, and, on the other hand, a dynamo builder is bound to offer his dynamo with several engines.

If the acceptance of a tender were based only on the amounts of these tenders, and the lowest bid were always accepted, this would not be necessary, but, of course, this is not the case, nor can it be. The decision is made not only with reference to the price, but also in view of the quality of the machine, its adaptability to the work to be done, and the reliability of the maker.

If 10 engines are offered and 10 dynamos, and they are offered separately, there are only 20 tenders from which to select two. If, however, the same engines and dynamos are offered combined, there may be as many as 100 tenders from which to select one. Furthermore, there may be only 80 tenders or some lower number than 100, and the combination desired may not be among them.

It is surely a matter that should be changed, and at once, for everybody's good.

For **Markham & Co., Limited.**
C. W. Whiting.

Chesterfield, *November 4th*, 1901.

We are very glad to see from the Leader in your issue of October 25th, and Messrs. Dick, Kerr & Co.'s letter in last week's Review, that there is a prospect of this matter receiving the serious attention it deserves.

As makers of slow speed engines for electric light and traction purposes, we frequently tender for contracts such as those referred to by you and your correspondents, and we feel strongly that the system of combined tenders for engines and dynamos, which has become so customary, gives rise to a large amount of unnecessary work and expense on the part of contractors.

In a recent case we had to prepare 15 complete specifications and drawings, besides receiving and despatching innumerable letters and telegrams, and, in order to comply with the terms of the specification, which called for a complete tender for engines and dynamos, and at the same time act fairly to those electrical firms to whom we quoted our engines, we had to analyse an equal number of specifications for electrical plant and submit full descriptions and alternative tenders to the purchasing body.

As Messrs. Dick, Kerr & Co. say, the added responsibility of quoting and guaranteeing another firm's manufactures cannot in fairness be undertaken by any contractor without a *quid pro quo* in the shape of a merchant's commission.

The practice of asking for combined tenders no doubt puts the responsibility on one contractor, and this may be found a convenience to the purchasers, but any inconvenience to the purchaser which the making of separate contracts might involve would, we think, be amply repaid by the financial saving effected.

D. Stewart & Co., Limited.
W. D. Bell, *General Manager.*

November 5th, 1901.

Supply Station Accounts.

I am pleased to see from Mr. Boot's letter, *re* supply station accounts, that the impression of many that his works were notorious for economy of wages is presumably wrong, but would at the same time ask if it is not somewhat strange that a works of the size of Tunbridge Wells should be able to dispense with the services of either electricians or engineers in charge, as that is the natural conclusion from his letter. The salaries of the two assistants mentioned do not seem extravagant. As for the men, I am afraid the engineer cannot help himself.

The Municipal Electrical Association has for one of its objects the improvement of the "status" of the station engineers, but apparently it is not the assistants who benefit from it.

"Pater" is quite right; committees shove too many ornaments into the profession, and every one who is worth his salt must wish to see some better means adopted for admittance as station engineers.

Assistant Engineer.

Marine Engineers.

A few months ago a friend of mine asked me if it were possible for him to put in his time at sea and then go up for his ticket. His training is as follows:—Electrical workshop bench, 6½ months; mechanical workshop bench, 2 years 4 months; assistant working engineer, 1 year; putting down electrical plant, 1 year 6 months; shift engineer, 14 months.

If any of your readers could enlighten me on this subject, I should be greatly obliged.

Shift Engineer.

Electrical Contracting and its Abuse.

The phrase "it not infrequently happens that the contractor has to look to his discount on the fittings for his profit on the job," in the letter from Mr. Sidney Frost I think you will agree justifies the heading I adopt.

How in the name of all that is wonderful has it come about that an industry which ostensibly is yet in its "swaddling clothes" has come to this pass? Also, what guarantee is there that in the course of a few years the profit on the fittings may not in the same hands also vanish?

The ordinary person who wishes his premises wired surely very rarely has any idea of the cost per yard of the wires or casings his contractor supplies. How then does it come about that a reasonable profit on their turn over is "not infrequently" lost?

These questions, Sir, I think are pertinent and require satisfactory reply before the fringe of the business, represented by the sale of fittings, should be subject to coercion.

Business, not Starvation.

Business Methods.

We beg to hand you herewith copy of memorandum we are sending to a number of firms from whom we received some time ago quotations for arc lamps.

We think that the publication of this memorandum may be the means of inducing manufacturers in this country to more readily accept conditions which are acceptable to competitors on the Continent.

We also direct your attention to the following notes :—

(*a*) The first was written by a firm in London when asked to replace certain electrical fittings broken in transit, because insufficiently packed.

(*b*) The second is a note received from our customer abroad, and is made in reference to the replacing by a Continental firm of 100 lamps complained of.

If the treatment of customers by Continental firms compares so favourably with that of British manufacturers, one can readily understand the preference by merchants and importers on the other side for the former.

Oswell & Strachan.

London, E.C.,
October 28th, 1901.

No. 1.—*Re* your quotation for arc lamps.

The following is an extract from a letter received from our customer abroad :—

We duly received your quotation, and after very careful comparisons regarding them, we regret that they cannot see their way to meet us with regard to the conditions specified. Messrs. ———'s representative (a German firm) here, however, has offered to supply us with a lamp on the specified conditions.

(*a*) From L———, London :—

With regard to the complaint made by your customer we are very much surprised to hear it. We have shipped these goods and similar ones to all parts of the world, and we have not had any complaints of broken goods owing to bad packing, and we certainly do not think these goods were improperly packed by us, and we must decline to be held responsible for the breakage.

We have not got any spare covers for these cut-outs in stock, but shall be pleased to order the quantity you name, provided you are willing to pay for them. We cannot say when we could deliver them, but would do our very best to get them off prompt for you.

(*b*) From ———, South Africa :—

We note that the lamps have been supplied to us gratis, and we thoroughly appreciate the way in which they have treated us.

Examination Test for Electrical Engineers.

I am very much interested in the correspondence which is now going on in your journal—viz., "Examination Tests for Engineers" and "Pay of Assistant Engineers." I quite agree with both your correspondents that it is high time something was being done in the matter. It is come to such a pass now that even in this week's number of your journal an advertisement appears for a *carpenter* to look after gas engine and electric plant. I am often asking myself if it is worth serving a long apprenticeship and undergoing the amount of study which one should do, when one sees berths given to men with little experience, who in some instances have never served an apprenticeship. The case stated by "Pater" in this week's number is by no means an isolated case. I served four years in the making and repairs of various kinds of engines, and finished my apprenticeship with a firm of electrical engineers. To get some experience in the running of engines I went to sea for three years, and was for half this time second engineer in a large boat. As I thought my theory of electrical engineering was rather weak, I determined to go to an engineering college. I may say I have no one to help me financially, or in any other way, so all my fees and keep during the time had to come out of my own purse. I left the college in June, having passed the examinations for electrical engineering. I had hoped, with the experience I have had, to get into a central station. But although I have answered advertisements by the score, my efforts have been unsuccessful. "Pater" says his son is now looking for a post at about £3 per week. I have tried to get any sort of a job as a start, and can't get 30s. Ever since I began to serve my time I have stuck fairly hard to my books. Dances, theatres, card parties, &c., I have kept away from, as I thought it would take me from my studies. And yet, after nine years' experience and study, and having deprived myself of all the enjoyments of life, I cannot even command a "salary" of 30s. per week. To make matters worse, I see men who have neither the experience nor certificates that I have, some not even steady, or having even served an apprenticeship, getting posts over me. I trust now the question has been started, some good results may come of the same.

A. Bennett.

November 4th, 1901.

Coal Consumption per Unit in Power Stations.

It seems a pity that "W. H. J." cannot afford more particulars than the few given in his letter of November 1st, page 708.

All he tells us is that he uses Welsh coal and steam of 160 lbs. pressure, not superheated, that he has a load factor of 50 to 55 per cent., and burns less than 2 lbs. of Welsh small coal per unit. Welsh coal points to a station in the West of England or in Ireland, and a load factor of 50 to 55 per cent. points to an average number of 125 running cars for the full station hours, so that the system driven by this station probably owns about 200 cars, and is of some considerable size. Excepting for the editorial note which enables us to gather an impression that the 2 lbs. of coal per unit is *not* the consumption per unit of output, as generally understood by station engineers, there is nothing in "W. H. J.'s" letter to tell us that the figures 2·0 and 1·9 do not represent the average of a month's consumption per unit. One unit is 1·34 I.H.P.

We are at liberty to assume that the units are measured at the switchboard, we may also assume that the overall efficiency of the engine and dynamo is not more than 84 per cent. Then $1{\cdot}34 \div {\cdot}84 = 1\,6$ I.H.P. generated in the cylinder.

For each unit of electrical output the indicated horse-power of the steam engines will be 1·6, and the coal consumption per I.H.P. calculated from 2 lbs. per unit, must therefore be 1·25 lbs. That is to say, there is somewhere in Great Britain or Ireland an electric tramway station, with a load factor of 50 to 55 per cent., in which wet steam is driving engines, only half loaded, with better economy than the highest class of triple-expansion marine engines specially constructed to run at a steady power, and actually run at that power for which the results are the best in economy.

Now it is certain that with a load factor (which is explained by "W. H. J." to be the running plant load factor, and not the station load factor) of 50 to 55 per cent., the steady load steam economy cannot be secured. It seems therefore quite justifiable to doubt any such coal consumption figures as 2·0 lbs. We are even asked to accept the figure, and allow it to include the no small amount of extra steam demanded by steam auxiliaries ! ! ! To the mind of every steam engineer, the figures point strongly to the necessity of overhauling the electrical instruments, and it would also appear just and fair to drop a post-card to the coal merchant, and suggest that his weighing machine is some very considerable percentage out of order against the coal merchant. We need not ask "W. H. J." to furnish us with particulars as to the type of plant at his station. We may assume, with an easy mind, that both boilers and engines, and generators, are each and severally the best of their respective kinds, and still the fact remains that the coal consumption is not one that we can reasonably be requested to accept as possible with engines whose load is continually varying from probably less than one-fourth to about double the mean load. If "W. H. J." would even send a strip of the recording ammeter paper to show that the variation of the load curve is different from all other tramway load curves, it would be interesting.

If there is no slip in "W. H. J's." calculations, could he inform us how he measured the current output and the coal; over what periods he calculated 1·9 lbs. of coal, and if not at least a month's consumption and output were taken as the basis of this low coal consumption, how was this found? A full statement of the methods employed would not divulge anything that would lead us to guess the station, though a load factor of anything over 50 per cent. narrows down our choice to very narrow limits

indeed, as to which see the table of electrical tramway systems in the *Tramway and Railway World*, and note those owning up to 200 cars.

As the figures have been publicly stated, in contradiction of the figures given in the Review, I understand, from actual running stations, the methods of calculation are equally entitled to be known.

Finally, it can scarcely be claimed that with the load factor named, the coal consumption of an engine can be less than 15 to 20 per cent. more than its consumption at maximum economy load.

W. H. Booth.

LEGAL.

The Electrolytic Plating Apparatus Company, Limited, *v.* Henry Holland & Co.

In the King's Bench Division of the High Court of Justice on Monday, Mr. Justice Ridley in this case had before him an action by the plaintiffs for an injunction to restrain the defendants, their servants and agents, from infringing the plaintiffs' patent, No. 5,274, of 1896, for an improved mixture for silver-plating by electrolysis; damages, delivery up of infringing articles, and costs as between solicitor and client were also claimed, the latter claim for relief being founded on the fact that in an action by the plaintiffs against Thomas Evans and Son, tried in the Walsall District Registry, Mr. Justice Wills had certified the validity of the patent. The defence was a denial of infringement, and a plea that the plaintiffs' patent had been anticipated by the patents of Cornforth, W. R. Lake, Zingsem, Richard Heathfield and W. S. Rawson.

Mr. Astbury, K.C., and Mr. Colefax appeared for the plaintiffs; Mr. T. Terrell, K.C., and Mr. A. J. Walter were counsel for the defendants.

Mr. Astbury, in opening the case, said that the idea of electrolysis ran through several patents, but the plaintiffs' patent was one for the mode of making the machine in order to get the best results from the process. The plaintiffs complained that the defendants had infringed by using a mechanism or apparatus which was the same as that described in the plaintiffs' letters patent. In particular, he said, the defendants had manufactured and used at their works, known as Salop Works, Highgate Park, Birmingham, an apparatus for the electro-deposition of metals, an essential part of which consisted in a perforated drum designed to revolve in the electrolyte, and having an axis which formed the negative pole, and with which the articles to be plated came in contact, either directly or indirectly, and were, thereby, plated, in infringement of the claim in the plaintiffs' patent.

Mr. Swinburne was called on behalf of the plaintiffs.

On Tuesday Mr. Bousfield, K.C., opened for the defence, and called evidence by Mr. Dugald Clerk, Mr. W. S. Rawson, and others. On Wednesday Mr. Justice Ridley gave judgment for the plaintiffs for an injunction, delivery up of the infringing machines, an inquiry as to damages, and costs.

Wigham, Richardson & Co. *v.* Walker Urban District Council.

In the Chancery Division, Mr. Justice Buckley on Monday heard this case.

Mr. Augustin Birrell, K.C. (with whom was Mr. Gatey), moved for an injunction to restrain the defendant Council from cutting, destroying, or injuring the electric mains supplying electric motive power to the plaintiffs' works. Plaintiffs carried on extensive ship-building works, and largely used electric power supplied by the gas company. These works were intercepted by Fisher Street, and part of the premises was in the defendants' district. Plaintiffs' mains were laid at a depth of 14 ft., and were carried under Fisher Street through a culvert which was the property of the plaintiffs. A dispute had arisen between the defendants and the gas company as to the right of the latter to supply electric power without their district, and there was also a dispute between plaintiffs and defendants as to the right of the former to have this culvert under Fisher Street. Plaintiffs had admitted that they were wrong in regard to the culvert, which they had filled up. Notwithstanding that there was no longer any dispute in regard to it, defendants were proceeding to cut up Fisher Street, though there was no sewer within 30 yards of the point where the defendants had begun cutting. There was the evidence of the plaintiffs' engineer that the excavations would interfere with the electric mains and seriously affect the plaintiffs' works.

His Lordship granted an interim injunction as asked over Friday (to-day), and gave leave to serve notice of motion for that day on the defendants.

Surrey.—The L.U.T. proposed extensions into rural Surrey have been very much modified, and the company will not at present proceed with the lines for Esher, Ewell, Cheam, Sutton, Carshalton, Beddington, Mitcham, or Croydon. It is, however, still proposed to obtain Parliamentary powers for lines from Kingston to Kingston Vale, from Malden to Wimbledon, from Hampton and Hanwell to Sunbury and Kempton Park, and from Hammersmith to Barnes and Mortlake.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Nov. 6th, 1900.		Week ending Nov. 5th, 1901.	
Brisbane	Value £63	Adelaide	Value £70
Buenos Ayres	44	Alexandria	159
,, Teleg. mat.	213	,, Teleg. mat.	695
Calcutta	832	Amsterdam	225
Cape Town	153	Bombay	328
Colombo	102	Calcutta	2,066
Copenhagen. Teleg. wire	38	,, Teleg. mat.	60
Durban	166	,, Teleg. cable	975
East London	235	Cape Town	261
,, Teleg. mat.	205	Colombo	181
Gibraltar	20	Copenhagen	271
Gothenburg	19	,, Teleg. wire	66
,, Teleg. mat.	39	Durban	442
Hamburg. Teleg. mat.	300	,, Teleg. cable	734
Hong Kong	171	East London	254
Liban	140	Flushing	5
Lyttleton	44	Fremantle	10
Madras. Teleg. mat.	100	Hamburg	82
Malta	153	Hong Kong	89
Nagasaki	9	La Plata	88
New York	92	Lyttleton	99
Ostend	71	Madras	88
Penang. Teleg. mat.	1,172	Melbourne	202
Perth	352	Moji	1,695
Port Elizabeth	655	Nagasaki	8
Port Said	15	New York	29
Shanghai	14	Ostend	8
Singapore	70	Penang	54
Stockholm. Teleg. mat.	79	Perth	34
Sydney	1,731	Port Said	55
Teneriffe. Teleg. cable, &c.	486	Singapore	24
Tokio. Telephones	90	Sydney	187
		Wellington	1,317
Total	£7,873	Total	£10,721

Foreign Goods Transhipped.

Durban. Elec. goods .. Value £70

Book Received.—"Les Applications Practiques des Ondes Electrique," by Albert Turpain. Paris: C. Naud, 1902. 12 francs.

Brill's Preston Works.—Our local correspondent says that the directors of the J. G. Brill Company, of Philadelphia, have selected Preston as the site of their proposed branch works in this country, after having inspected various towns in the Midlands and North of England. Land has been acquired near the docks, and the Corporation will afford the necessary approaches. The works will, it is stated, give employment to about 500 men, and turn out about 1,000 cars and 4,000 trucks annually.

Dissolutions and Liquidations.—A meeting of the Edwards Electrical Company, Limited, is to be held at 14, Bedford Row, E.C., on December 21st, to hear an account of the liquidation from Mr. A. E. Darville, the liquidator.

The Gateshead Electric and Mechanical Supply Company is winding-up voluntarily, with Mr. W. T. Price, 21, Collingwood Street, Newcastle, as liquidator.

Messrs. H. D. & L. Barlow (Barlow Bros. & Co., electrical engineers, 237, Shaftesbury Avenue, W.C.) have dissolved partnership. Mr. H. D. Barlow attends to debts, &c.

On behalf of a debenture holder, Mr. Druce on Friday applied to Mr. Justice Farwell for the appointment of a receiver and manager of the Colwyn Bay Electric Light and Power Company, on the ground that the security was in danger. There was no opposition, and the order asked for was made, the period during which the manager should act being restricted to three months.

Earle's Ship-Building Company.—From the circular letter which has just been sent out by the receiver and joint liquidator, Mr. W. C. Jackson, it appears that there is nothing remaining either for creditors or shareholders. In fact, there is not sufficient to cover the second mortgage and interest. The works, &c., have been bought up by Mr. C. H. Wilson, M.P., for £162,500.

For Sale.—One each 20 and 9-N.H.P. gas engines, and two compound-wound dynamos are offered for sale at Newtown, where, the central generating station being now completed, they are no longer needed. See "Official Notices" to-day.

Messrs. Percy Huddleston & Co. are, on November 13th, to sell some engineering plant by auction at Canvey Island, Essex. See our advertisements for details.

G.E.C. Football Club.—The first eleven of the club are this year competing for the Leyton and District League Cup. Their ground is at Wadham Lodge, Walthamstow, and any electric firms requiring fixtures are asked to kindly apply to Mr. G. Brock, hon. secretary, G.E.C. Football Club, 71, Queen Victoria Street, E.C.

Glasgow Exhibition.—Referring to our description of the Schuckert Pavilion in last week's issue, we are informed that the starter for the large pump is not fitted with circulating water pipes, but is simply placed in an iron tank filled with water, which enters at the bottom, and flows out at the top. Actual experience shows that the water cooling arrangement could be entirely omitted, as the water does not get warm at all, even when the motor is started frequently. The motor driving the windlass referred to on p. 701, is shunt-wound, not series-wound, and has an output of 7 B.H.P. at 1,230 revolutions per minute (not 450 revolutions per minute); this exhibit is the same as that referred to on p. 703.

Oldham v. Waring & Gillow, Limited.—The hearing of this remitted action referred to in our issue of October 4th has been postponed until 12 o'clock noon on Monday, 11th inst., at Westminster County Court.

Trade Announcements. — In consequence of the reconstruction of S. Z. de Ferranti, Limited, the name of the company is now *Ferranti, Limited*, and all communications should be thus addressed.

Mr. L. G. Caunter has resigned his position at Messrs. Veritys, Limited, and has joined Mr. Alfred Baxter in partnership at 5, Macclesfield Street, Shaftesbury Avenue, W.C. Messrs. Baxter and Caunter are sole agents for the Newton Electrical Works, Limited, Taunton, &c.

Westinghouse Factory.—We read in the *Electrical World* that a contract has been closed by the London office of the Buffalo Forge Company with the British Westinghouse Electric and Manufacturing Company, Trafford Park, Manchester, for apparatus to be used for heating and ventilating the machine shop, foundry stores, the carpenters' shop and box factory of the new works. The machine shop is 900 ft. long, 420 ft. wide, and 59 ft. high. To heat and ventilate this area, eight steel plate fans, each capable of delivering 60,000 cubic feet of air per minute, and driven by a separate induction motor, will be provided.

Some 400 joiners in the employ of the British Westinghouse Company, Trafford Park, struck work because it had been decided to allow only half an hour for dinner, instead of a full hour. The alterations, however, provide that, in consequence of it getting dark so early in the evenings, they shall leave at 5 o'clock, instead of 5.30.

What the British Consuls have to Say.—*Telegraphic Progress in Angola.*—Consul Nightingale, in his report on the trade and commerce of Angola, received at the Foreign Office on October 8th last, states that the extension of telegraphic communication continues, the line between Loanda and Santo Antonio do Zaire being now opened, and the one to Novo Redondo—to the south of Loanda—is now nearly completed. When it is considered that in 1895 there were but 220 miles of telegraph line in the whole of Angola, and that to-day there are 1,580 miles open for traffic, some idea may be formed of the attention that has been given towards bringing the different parts of the province in touch with each other. At times communication is interrupted through the falling of the wooden posts, jungle fires, lightning, or the ravages of the white ant, dry rot, &c., but it is probable that the wooden posts will be replaced by iron posts, especially for the line between Loanda and the Congo. There is a through rate of service to Europe for the principal stations in the province, the number of telegrams sent to Europe by this rate during 1900 being 278, or 2,242 words. The total number of telegrams dispatched during the year was 27,632, or 246,176 words. The gross receipts for the year amounted to £2,035, while the expenditure was £4,657, and extra expenditure on extension of lines £3,315. Although the expenditure exeeeds the receipts by more than double, Consul Nightingale points out that of the telegrams sent 9,414 were on Government service.

Electric Lighting, Telephones, &c., in Huelva (Spain).—Consul Vecqueray, in his report on the trade of the consular district of Cadiz for the year 1900, states that the Rio Tinto Pier at Huelva has been provided with an installation of electric arc lamps whereby night work has been greatly facilitated, and the large depôt of the Tharsis Company, within about a mile of the pier, has also been lighted by electricity. Huelva Town Pier has also been filled with arc lamps, and Ayamonte and one or two smaller towns in the district have been provided with electric light during the present year, the work being done by a Belgian firm, who also found a large part of the necessary capital. A concession was granted last year for a much-needed public telephone system in the town of Huelva, and the service was inaugurated in June this year. In a new scheme for the construction of a new wharf in connection with the harbour at Huelva, two electric cranes are provided for in each berth, or eight in all, each of 2½ tons capacity.

Electrical Industry at Baden.—Consul Ladenburg, reporting on the trade and industry in the Grand Duchy of Baden for the year 1900, remarks that the electrical industry, which a few years ago promised to conquer the world, and in 1899 suffered a decline, went back further still in 1900. Orders, he states, might be had, but in face of the higher cost of material and the difficulty of obtaining capital, electrical plant does not pay, and even for illuminating it is complained that municipalities charge too high prices.

Electrical Machinery in the Russian Oil Fields.—Vice-Consul Forbes, in his report on the trade of Baku, in the Batoum consular district, states that the development of the oil industry has naturally led to a very large demand for machinery, and in meeting this demand the British manufacturer has secured the largest share. But in the electrical industry the British manufacturer has been outstripped by the German. He remarks: "I may safely say that no electrical machinery of British manufacture is in use in this district, and several large electrical power stations of an aggregate of 10,000 H.P. are at present being equipped by German firms. These power stations are intended to supply electricity as motive power on the oil field as a substitute for steam. The success of these projects is as yet problematical, as there are difficulties connected with the use of electricity in this field which will be very difficult to overcome, and which must be overcome before the success anticipated can be realised."

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—During the past week the demand for electricity became so great, that on Thursday and Friday the load was close up to the capacity of the works in Cotton Street, and it became absolutely necessary to take power from Dee Village. The electric staff, under Mr. Bell, set themselves to cope with the situation; temporary cables were promptly laid, and at five o'clock on Monday afternoon the staff were in a position to ask the convener, Mr. Kemp, to switch on the first engine at the new works. It had been expected that it would not be necessary to take power from Dee Village for another week or two, when the other three engines now in position would be ready for turning on by the Lord Provost.

Barnstaple.—The T.C. has obtained the sanction of the L.G.B. to the borrowing of £21,600 for electric lighting. An additional £5,400 for the extension of the system is at present refused.

Bath.—The effects produced by a powerful electric searchlight used on the occasion of the Mayor's reception in June, have led the E.L. Committee to purchase one which anyone will be able to hire. The idea, as an additional source of income, even though a small one, may be worthy of imitation.

Blackburn.—A fierce dispute is still raging in the local press as to the respective merits of high and low speed engines. The contest practically lies between the Belliss and the Yates and Thom engines, and lengthy arguments, wise and otherwise, have been adduced on both sides. Both types—of engines, not arguments—have their good points, but, no doubt, as usually happens, the result will be decided by some consideration quite foreign to the question of merit. Unfortunately, a personal element has been imported into the discussion, it being alleged that the chairman of the Electricity Committee, Mr. W. Thompson, the electrical engineer, Mr. A. S. Giles, and one of the consulting engineers, Mr. E. M. Lacey, were interested financially in the Belliss Company. The chairman sold his shares early in September last, but the engineers both parted with theirs in 1899 and 1900, and in none of these cases was the interest more than 100 preference shares out of 15,000 authorised. The contention that these gentlemen are biassed by personal interests appears to us to be perfectly absurd, and we trust that it will not be allowed to influence the Council in arriving at a just decision.

The position taken up by one of the local papers on the subject may be summed up as follows:—Not only must public officials be without shares in companies which deal, or may deal, with their municipality, they *must never have held* shares in such concerns! Such a proposition is so preposterous that we fear some weight may be attached to it by the readers of the paper concerned, for apparently the most absurd statements nowadays are the most readily believed. We need not dwell on the point that no one can foresee his future; the adoption of such a principle would be fatal to industry.

Bournemouth.—The T.C. has resolved to apply for an order under the Electric Lighting Acts for the parishes of Winton and Pokesdown and part of the parishes of Holdenhurst and Southbourne.

Carnarvon.—The T.C. has resolved to apply for a prov. order for electric lighting.

Colwyn Bay.—A L.G.B. inquiry has been held by Mr. A. A. G. Malet, in reference to an application by the U.D.C. for leave to borrow £85,000, including £8,450 for extensions of the electricity works. Mr. Clirehugh, the Council's electrical engineer, explained the need of additional plant and mains, and there was no opposition.

Cromer.—The U.D.C. has decided to adopt electric lighting, and the Council has accepted an offer made by the Edmundson's Electricity Corporation, Limited, namely, that the Council should raise a loan, and the Corporation would provide the plant, and pay the principal and interest on the money for 14 years. The scheme will cost, approximately, £20,000. Mr. Cozens-Hardy is the engineer to the U.D.C.

Dewsbury.—The T.C. has approved the appointment of Mr. R. H. Campion, of Blackburn, as electrical engineer at a salary of £300 a year.

Dunrobin Castle.—It is reported that the Duke of Sutherland intends to put down electric lighting plant for the illumination of Dunrobin Castle and other buildings. The old mill is to be renovated and made suitable as a generating station.

East Grinstead.—The D.C. has refused to apply for a prov. order.

Easthampstead.—A large installation of electric light and power plant, driven by oil engines, is being laid down by the Marquis of Downshire at Easthampstead Park. Messrs. Adams and Williams are supervising the work.

Edinburgh.—The Museum of Science and Art is to be lit by electric light at an estimated cost of £4,000.

Epping.—The U.D.C. has postponed indefinitely the question of applying for electric lighting powers.

France.—The Communal Council of the town of Cannes has approved of a project for the installation of an important central power station with the object of supplying motive power and lighting to the town and suburbs, both for public and private uses. The power station will be built at Saint Cézaire. The concession has been secured by M. Natanson.

Garston.—The D.C. has appointed Mr. O. Hansom, of Fleetwood, consulting electrical engineer, to report on the tramway and electrical works in the township.

Germany.—The Verein zur Prüfung und Uberwachung Electrischer Anlagen is the title of a new association which has just been organised in Berlin for the purpose of independently testing and supervising electrical installations of all kinds for its members.

Huddersfield.—The Committee inquiring into various complaints about the manner of municipal administration, lately considered the circumstances under which Mr. J. A. Stocks—a brother of Alderman Stocks, chairman of the Gas Committee—was employed to do various work in connection with the extension of the gasworks and the electric lighting works. The report of the Committee completely exonerates the parties concerned.

Italy.—The engineer, Giovanni Corradi, of Genoa, has applied to the Sub-prefecture of Domodossola for the concession of a catchment of water from the Loana torrent, on the territory of Malesco. The catchment would be of a maximum of 100 litres per second and an average of 50, and would be employed for the production of motive power for the generation of the electric energy necessary for the lighting of the numerous communes in the valley of Vigezzo.

Kanturk.—The residents are strongly in favour of the introduction of electric lighting into the town. There is a good water-power in the district, and it is proposed to invite a company to carry out the work.

King's Lynn.—The second steam dynamo has been started, completing the extension works. There are now two sets of 200 and 120 KW. respectively; the five gas-driven sets, of 200 KW. in all, are to be held in reserve, or sold.

London.—City.—The Court of Common Council has declined the recommendation of the Streets Committee to defer the consideration of the City Electric Lighting Company's letter till February, and instead has appointed a special Committee to report on the matter forthwith.

Bermondsey.—The Corporation gives notice of application for powers for extension of area of supply.

Wandsworth.—A lengthy report upon the possibilities of utilising the Borough Council's dust destructor at Tooting has been prepared by Mr. W. P. Adams. The borough has 45,000 tons of refuse to dispose of annually.

Islington.—An explosion took place in a manhole on Friday last, followed by a fire, which was quickly extinguished.

Lowestoft.—The T.C. intends to apply for a license to supply electricity in Oulton, Oulton Broad, Carlton Colville, Kessingland, Gunton, and Corton.

Manchester.—One of the new engines at Bloom Street generating station has started working, and the Electricity Department of the Manchester City Council is now dealing with new customers in the order of application.

The E.L Committee intends to apply to the L.G.B. for leave to borrow £25,000 to cover expenditure during the next three years.

Mitchelstown.—The ratepayers have passed a resolution in favour of electric lighting for the town.

Nairn.—The T.C., alarmed by a notice to the effect that Messrs. Crompton & Co., Limited, intended applying for electric lighting powers, has resolved to obtain a prov. order.

New Barnet.—The East Barnet U.D.C. has instructed Mr. W. P. Adams to report upon the electric lighting of the district. The Council holds a prov. order, and has been approached by the North Metropolitan Power Distribution Company, who wish to give a supply "in bulk," and by companies who desire to establish a complete undertaking.

New South Wales.—A company has been formed for generating electricity at Colo River, New South Wales, and it is proposed to supply Sydney and Newcastle, among other places.

North Berwick.—The T.C. has resolved to apply for a prov. electric lighting order.

Northumberland Coalfield.—It is stated that a powerful syndicate is being formed for the purpose of erecting a power station in the heart of the Northumberland coalfield, in order to supply the collieries with light and motive power. The Northern Counties Electricity Supply Company is applying to Parliament for powers to run trams in the same district, and will take electricity in bulk for both lighting and traction from the new company. The district to be worked by the tram company will extend from the Ashington group of pits down as far as Bebside, Cowpen, and Newsham. The new power company will be formed under the title of the Northumberland Electric Power Company.

Paignton.—The D.C. has passed a resolution in favour of supporting a company which will obtain and carry out electric lighting and tramway powers in the district.

Pembroke.—The Naval Estimates for next year, says the *Naval and Military Record*, will probably include a provision for the erection of an electrical engine house and storage station at the rear of the new electric shop. In pursuance of a decision practically arrived at several years ago, provision will also be made for a permanent electrical installation to be carried through every department. At present the arrangements are of a temporary character, although the machinery in the new pattern shop and the electric shop is driven by electric motors.

Perth.—The E.L. Committee is in negotiation with Messrs. Crompton & Co., Limited, regarding the lighting of the town.

Portsmouth.—Mr. F. H. Tulloch has held a L.G.B. inquiry in reference to an application from the T.C. to borrow a further sum of £23,000 for the purposes of electric lighting.

Rhosllanerchrugog.—Considerable inconvenience is being caused by the prolonged dispute as to the price of gas between the gas company and the Parish Council, the town being in complete darkness. The Parish Council has resolved to invite Mr. G. R. Peers to give information as to the cost of electric lighting.

Spain.—A large number of factories at Cordoba, which derive their motive power from an electric light and power company, have had to shut down, as (says the *Financial News*), on account of the drought in the province, there is no water to drive the company's turbines.

Stirling.—The T.C. has resolved to borrow £12,000 for the electricity supply extension works.

Swansea.—A failure of the electrical supply occurred on Sunday evening last. It turned out that the mishap was due to the carelessness of a workman, who, after testing the mains in the morning, forgot to switch on the battery, which is used for supply on Sundays without attendance.

Swindon.—In view of the decision of the T.C. to lay down an installation of electric light, the two local gas companies have formulated a scheme for amalgamation, which has received the unanimous approval of the shareholders.

Warrington.—The L.G.B. has authorised the borrowing of £15,000 for electric lighting. The E.L. Committee recommends that application be made to the L.G.B. for sanction to borrow £1,000 for the purchase of electric motors.

Wellingborough.—The Electrical Power Distribution Company is going to lend the Council certain machinery temporarily, which will save the Council a capital outlay at the beginning of about £1,000.

West Hartlepool.—A L.G.B. inquiry was held by Mr. R. H. Bicknell on Tuesday last, on an application made by the Corporation to borrow £5,610 for purposes of electric lighting.

Winnipeg.—The first steps have been taken with a view to bringing in electric power from a point on the Winnipeg River near Whitemouth, about 48 miles from the city. The project is one of immense scope, and will prove of great benefit to the city. From 50,000 to 100,000 H.P. is to be dealt with.

Wood Green.—The D.C. has passed a resolution to apply for a prov. order for electric lighting.

Worcester.—Mr. H. P. Boulnois held an inquiry on behalf of the L.G.B. on Tuesday into the City Council's application for sanction to a loan of £30,450 for a supplemental generating station, buildings, and machinery. There was no opposition.

ELECTRIC TRACTION NOTES.

Anglesey.—Mr. Bennett (of Messrs. Bennett & Ward Thomas, Manchester) has appeared before the County Council with plans of a proposed light railway between Valley and Amlwch, for the purpose of obtaining a resolution passed by the Council approving of the scheme, so that the promoters might go before the Light Railway Commissioners.

Austria.—A preliminary concession has been secured by the Bohemian Electrical Company, of Prague, in respect of a projected light electric railway between Prague and Bad Houschka.

Belgium.—Several Belgian contemporaries announce that the project of an electric railway between Antwerp and Brussels has finally been approved of by the Government, and that M. Empain's project providing for a terminus in Brussels contiguous to the future city station of the proposed Metropolitan has been adopted in preference to the proposal of having a terminus near the Gare du Nord. According to the reports in question, the speed stipulated for is 125 to 150 kilometres per hour, and a five-minute service without intermediate stop. We have good authority for stating that this announcement is a little premature. It is true that the Belgian Government has had under consideration for a long time past the question of constructing a second railway between Antwerp and Brussels in view of the congested state of traffic, and the Cabinet is favourably disposed to the application of electricity for this purpose, but for the transport of passengers only.

The question has been up for consideration at several recent meetings of the Cabinet, and postponed for decision pending further information.

Belfast.—At the County Antrim Council, in Belfast, the Finance Committee reported that a letter had been received from the B.E.T. Co. stating that they had been requested to promote a Bill in the ensuing Session of Parliament for the electric equipment of the Whitewell and Cavehill tramway.

Birkenhead.—On Friday, at the Birkenhead Police Court, a baker was summoned for obstructing and impeding the traffic on the line of tramway in Balls Road East, on September 28th. The case was viewed as a test case. The defendant had held the premises at the corner of Woodchurch Road and Balls Road East from a time prior to the construction of the tramways. When the lines were laid down, a space of 4 ft. 6 in. only was left between the kerbstone nearest the defendant's premises and the nearest tramway line. A van or wagon standing by the kerbstone at that point accordingly extends over the line, and may impede the traffic. On the day in question one of the defendant's vans was being loaded, and impeded the passage of an electric car for four minutes. For the defence it was contended that defendant's premises had been there before the tramways, and that if he were required to load and unload his vans at the other side of the road, it would involve expense and loss of time. Whilst sympathising with the defendant the magistrates found that there had been a wilful obstruction, and imposed a fine of 10s., including costs.

Carshalton.—The poll of ratepayers on the tramways question was declared last week with the following result:—For the introduction of tramways, 317; against, 210—plurality in favour, 107. About half the electors polled. Future action will be decided at a special meeting of the U.D.C.

Cheadle and Gatley.—A specially convened meeting of the Cheadle and Gatley Urban D.C., held last week, considered the report of a deputation relative to the electric tramway service, in presence of representatives from the Stockport Corporation. After the discussion of preliminaries, the two bodies came to terms. These indicated that the Stockport Corporation are to pay the cost of construction and to work the trams for 20 years. After that time the Corporation agree to pay the District Council 10 per cent. on the profits of the route, and at the end of 30 years the permanent way to belong to the Cheadle authorities, the Corporation meanwhile to keep the whole system in repair. These terms were accepted by the Council.

China.—Mr. T. Philip Terry, of Shanghai, who represents the interests of a number of American manufacturers of various machinery in the Chinese markets, has recently been on a visit to the United States, partly, says the *Electrical World*, with a view to placing some fair-sized contracts for electrical equipment, &c.

Dublin.—Quite a crop of electric tramway cases came before the Recorder of Dublin at the Quarter Sessions just held. Three actions were taken by three different men against the Dublin United Tramway Company for injuries alleged to be caused by the centre standards of the company's system. The main points of the evidence in each case were the same, and went to show that the plaintiffs at the time they received the injuries complained of were outside passengers on the company's cars, the wire protection on some being sworn to be 4 ft 6 in. and on others 1 ft. less. The standards, which in Mount Street where the accidents occurred, are in the centre of the street, were in each case the cause of the injuries, while plaintiffs were slightly leaning over the side of the car. The conductors of the cars were cognisant of the fact that there were no seats on the top for the plaintiffs, and accepted the fares from them while they were standing. Counsel for plaintiffs submitted that these standards were a source of positive danger, while, on the part of the tramway company, it was held that no accident could occur except through gross negligence. The Recorder said that, in view of there being three accidents, the question became a very serious one, and he must take time to consider his decision.

Master Pigot and a jury of six sat last Friday in the Master's Office, Four Courts, Dublin, to assess damages in the claim of Patrick Dowling against the Dublin and Lucan Tramway Company. On August 7th, while travelling on one of the defendant's cars, he received a blow on the head from the car trolley, from which he had not yet recovered. The jury awarded the plaintiff £80.

France.—An important system of electric tramways is projected in the Department of Puy-de-Dôme. The scheme, which aims at the utilisation of numerous waterfalls in the district, has just been presented to the General Council of the Department. The total length of the proposed system is 176 kilometres. These lines will be of one metre gauge. It is proposed to carry both goods and passengers, the rate for the latter being, 1st class 10 centimes per kilometre, and 2nd class 7·5 centimes. The concession both for the waterfalls and tramways would be for a term of 75 years, and embraces no less than 23 waterfalls.

The Municipal Council of Angoulême has decided to subsidise, to the extent of 50,000 francs, a new system of tramways to be constructed in the town.

Halifax.—The Corporation are promoting a Parliamentary Bill, a clause in which empowers the Corporation to convey wagons, goods, &c., to and from the railway stations over their tramway system. The Corporation have during the past week been questioned by the Postal authorities as to the conveyance of postal mail wagons over their system.

Ilkeston.—A formal commencement to prepare for fixing the electric tram rails was made on Monday morning at Hallam Fields, the south end of the service.

London.—The Light Railway Commissioners sat at Tottenham last week to hear the application of the B.E.T. Co. for an order under the Light Railways Act, authorising the company to make and use certain light railways in the counties of Middlesex and Essex. A number of the lines originally proposed were abandoned, owing to the opposition of local authorities, and the remaining seven lines affected Tottenham and Walthamstow, the total length being 4½ miles. The scheme was opposed by Mr. Hutchinson for the Urban District Council of Walthamstow, who desired to undertake for themselves the construction of light railways in their district. Lord Jersey announced that the Commissioners had decided not to allow the scheme to proceed so far as regarded the Walthamstow portion, and the promoters thereupon elected to drop the remainder of their scheme.

Luton.—There is a scheme on foot for an electric line between Luton and Dunstable. The syndicate which is dealing with the matter has been approached to induce it to go as far as Leighton Buzzard.

Manchester.—We read in a Yorkshire paper that the first meeting to consider a proposed scheme for a Manchester suburban light electric railway was held at Manchester on 29th ult., Mr. C. H. Berry, engineer, of Manchester, presiding. The districts to be served by the first section of proposed railways are the southern and south-eastern suburbs of Manchester, from Sale to Stalybridge, a distance of 26 miles. It is proposed to lay a single line with the overhead trolley system of traction. A committee was formed, with instructions to proceed with registration of the syndicate and the obtaining of the necessary order. It is hoped by the promoters to commence work in about 12 months, and to have the whole line completed in about two years. The proposed capital of the construction company is £300,000.

Middlesex.—The Light Railway Commissioners (the Earl of Jersey, Colonel Boughey, R.E., and Mr. H. A. Steward) held an inquiry into the light railway schemes affecting the districts of Friern Barnet, Hendon and Finchley, promoted by the Middlesex County Council, at East Finchley, on Thursday, October 30th. After a protracted sitting, the inquiry was adjourned until Tuesday last at the Guildhall, Westminster, and the result was that the Commissioners granted the order in so far as regards the small portion in Friern Barnet, along the Regent's Park Road to the county boundary, and from The Castle, Childs Hill, along Cricklewood Lane to the Edgware Road, where the Council already hold a provisional order, the latter authorising a light railway from The Crown, at Cricklewood, to Edgware.

Mountain Ash.—At a meeting of the U.D.C. on Tuesday it was decided to apply to the Board of Trade for an order authorising the Council to construct electric tramways and to appoint a committee to deal with the matter.

Newcastle-on-Tyne.—The City Council on October 29th discussed the question of proposed tramway extensions. The committee having charge of the electrical tramways which, it may be stated, are not yet running, proposed three notable extensions—to Benwell, to Seaton Burn, and to Wallsend, as well as some minor extensions, which will have the effect of making some of the routes into circular ones.—Mr. Cail moved the adoption of the report, and said that it was time for them to be moving, for it was rumoured that another company were proposing to run trams from Blyth through Seaton Burn to the city boundary. He pointed out that the races that were held at Gosforth Park would bring a very considerable traffic to their trams if constructed, and they would also tap the villages of Weetslade, Dinnington, and Seaton Burn.—Alderman Richardson characterised the proposal as one of the maddest he had heard of. The Corporation had borrowed £500,000 already for the trams, and in 18 months they would need a quarter of a million more.—Alderman Baxter Ellis said the seven days' racing at Gosforth would be sufficient to recoup them both for interest and capital.—Sir William Stephenson also opposed the scheme as being foolish to run into so much debt. In the last 60 years they had increased their debt by 300 per cent. When they borrowed the original £400,000 they were told that it would be sufficient for the tramways, but he thought it would be at least double that amount.—Mr. Cail said the £400,000 borrowed was for the track only. The directors of the Gosforth Park were prepared to negotiate with them, and give them something towards the trams. Several speakers spoke of the value of the trams in opening up the country and lessening the congestion of the town.—The motion for the adoption of the committee's report was then put and carried by 28 votes to 9. The Bill was then formally approved and carried, an attempt to prevent the Corporation from starting any new work outside the city limits before they had completed that in the original Bill being defeated.

Singapore.—The Municipal Commissioners have passed a resolution signifiying that they are willing to agree to a concession for constructing and running electric trams in Singapore, on condition that they be given the right of re-entry within 10 years in payment of the then actual value and a percentage (1/4) as compensation, and that the right of constructing tramways on roads not used by the company and of crossing the company's lines at any point be reserved to them and subject to the details of the scheme being approved by them.

(*Continued on page 769.*)

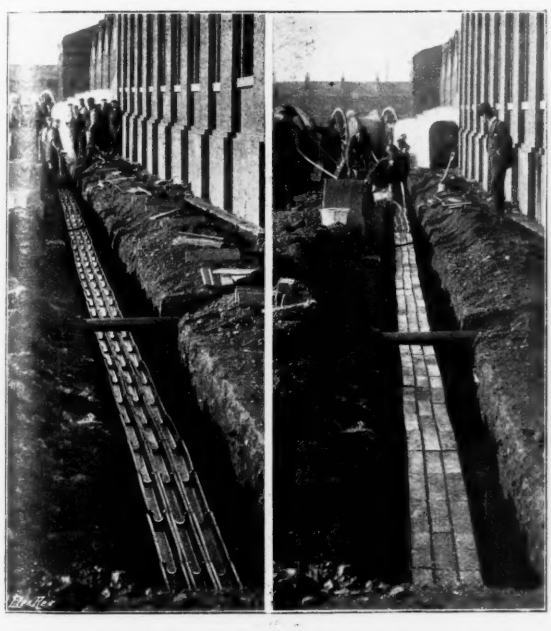
Some Fittings, Appliances, and Novelties for the Current Lighting Season.

The electric lighting season is now in full swing. The electrical contractor is in the thick of his wiring work, hurrying forward the completion of house installations all over the country, so that the public may, at the earliest possible moment, dispense with other illuminants, and switch on the electric light. The station engineer is gathering up available resources, preparing for all he is worth to meet the heavy demand for energy which is bound to arise during the next few months. The manufacturer of, and the trader in, electric lighting fittings, switches, and the thousand and one appliances and accessories required in connection therewith have stocked their showrooms and their stores with the latest designs and novelties, and are doing a pretty brisk business. We have thought that in view of these facts electrical engineers would like to have brought before their notice some of the leading lines which manufacturers are now placing on the market.

Siemens's Solid System of Main Laying.

Messrs. Siemens Bros. & Co.'s solid system of laying underground electric light and power mains, which we illustrate, is a method of laying mains in troughs which are afterwards filled with compound. The pictures show two stages of the installation of the system and the type of trough.

The troughs are made of hard salt-glazed stoneware, in lengths of about 2 ft. The ends fit together, in somewhat the same way as a spigot and socket joint, thus affording resistance to lateral displacement. A special feature is that the spigot piece is made to form a bridge for the cable. Several bridge pieces of wood or other material are thus avoided. The covers of the troughs are made of strong hard stoneware slabs, and are thickened to project into the troughs so as to avoid any liability to displacement during the filling in of the trenches. No cement or other jointing material is required. True alignment is obtained, and the surface finish of the troughs is such as to safeguard against damage to the cable by sharp edges. The standard sizes of trough carry one main only, but the troughs can be



Troughs Ready to Receive Cables. Troughs after Filling in and Covering.

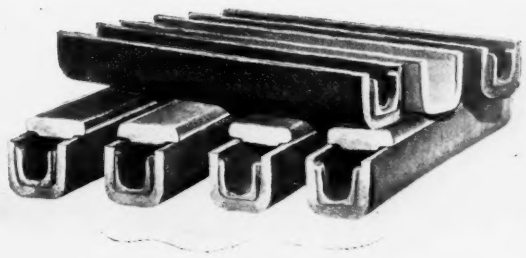
made to accommodate any reasonable number. Where a number of mains are laid side by side, and separate troughs employed for each, it is claimed that the Siemens troughs will occupy much less ground space than any type with external jointing pieces, as the absence of such expanded portions or projections allows of adjacent troughs being laid closely side by side, and a saving in trenchwork is thus secured. This applies to a run of troughs from which no branch connections would be made; but in the event of a distributor being run in the same trench as other mains, it would, of course, be so spaced that the service joint-box could be inserted at any point.

For through joints in the mains a type of junction should be employed which does not involve any alteration in the size or type of trough, as it is an advantage to have as few patterns as possible. The Siemens patent non-hygroscopic joint is claimed to meet this requirement, and to do away with the necessity of making joints in the lead, thus effecting a saving of time. In this joint the conductor ends are sweated with special soft solder into a brass tube, and insulated with layers of patent non-hygroscopic tape, which is extended over both ends of the lead casing. A lead tube previously slipped over the cable is drawn over the joint, and its ends then clamped and bound down with wires on the non-hygroscopic tape, which acts as an elastic packing and ensures a perfectly water-tight joint.

For consumers' connections a stoneware box is supplied, similar in all respects to the main run of troughing, with a T branch for the service line and a stoneware lid to cover the whole. It can be readily substituted for a length of the trough, and is completely filled with the same compound that is used for the mains. The joint in the main is made with the patent non-hygroscopic material previously described. Where the service connection has to cross a line of troughs laid alongside the distributor, it is advisable to employ a special cast-iron jointing box.

Where disconnecting boxes are desirable the troughs are finished off in a brick pit with a cast-iron manhole cover. A water-tight cast-iron box, with the necessary internal fuses and fittings for effecting any required disconnection or combination of mains for testing or other purposes, is placed inside the pit, and the mains are led into this box. It is filled with a special insulating compound when all connections have been made, only the disconnecting links or fuses being above the level of the compound.

We may briefly add a note of the advantages which are claimed by the manufacturers of this system:—Perfectly water-tight mains; protection from mechanical or chemical injury; prevention of gas accumulation; separate mains are readily accessible. Its essential features may be summarised thus:—Strong trough of imperishable material; practical immunity from any lateral movement is secured; the cover so fits the trough, that displacement is prevented; the filling-in compound sets quickly, and is acid proof; mains can be easily jointed, and have a waterproof covering; and consumers' services can be readily connected.

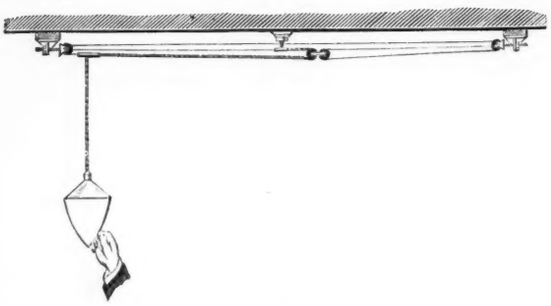


Troughs for Siemens's System of Main-laying.

The "Traveller" Light Fitting.

In our illustration on the next page we show a new system of lighting, introduced by Mr. H. O. Farrell, 106, Princess Street, Manchester, intended for places where it is necessary from time to time to change the position of the lamp. It hardly needs pointing out that such an arrangement will in some cases, especially where lights are required for a few moments at a time at different points in a warehouse or shop, save the cost of installing several other lamps, and also keep the account for energy and lamp renewals low. For Farrell's patent "Traveller" light, as it is called, it is claimed that it is simple, inexpensive, and durable. It is especially recommended for such places as goods sheds on docks and railways, libraries, works' stores, and premises of a like character. The outfit essentially consists of two brackets with grooved pulleys, which are fixed to the ceiling or wall at a suitable distance apart, and a running block. The flexible insulated wire is led from a ceiling rose in the usual way, and is connected to a draw cord. The wire and the draw cord are passed round the pulleys and block in such a manner that the pendant light can be drawn along by the hand to any position between the two brackets, while the wire and the cord are always

kept taut and out of the way. The pulleys are not rigidly fixed to the brackets, but are connected to them by ball joints, so that if the cord is pulled toward one side in moving the light the pulleys swing into line with it, and there is said to be no danger of it running off them. Means of adjustment are provided for stretching the cord

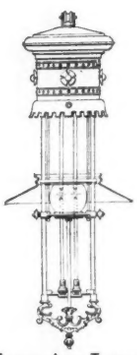


The "Traveller" Light Fitting.

taut should it become slack with use. It is claimed as an advantage that there are no springs, ratchets, or any delicate mechanism of any kind likely to get out of order. The apparatus is supplied with a movement, or "run," of any length up to 50 ft., but where necessary longer runs can be arranged for.

Union Arc Lamps.

In order to meet conditions where only one lamp is required on 100 to 115-volt circuits, or two lamps on 200 to 230-volt circuits, and at the same time secure good lighting economy and low first cost, a new pattern shunt lamp (the F.U.W. pattern) has been constructed, and is already in extensive use. The striking and feed are controlled solely by shunt coils, so that the ampere capacity of the lamps can be varied without affecting the regular burning, even after they are installed. Each coil has fitted to it the K. and M. patent heat compensator, which enables lamps to start and continue to work with the same (and therefore correct) arc or terminal voltage. The lighting economy, and consequently the economy of current consumption, is claimed to be, as compared with an enclosed lamp of any type burning on the same circuit, from 30 per cent. to 40 per cent. The outfit of the lamp illustrated is specially designed for interiors of shops and similar spaces of moderate height, in which it gives an even distribution of illumination. Many other standard features are made to suit other requirements. The feature of this lamp, common to all other K. and M. lamps, is that all the current-carrying parts are insulated either by mica or by glass beads. The body of the lamp, including slide rods and gear, does not form part of the circuit, and is insulated from it also there are no rubbing or moving contacts. All the parts of the lamp are made on the factory system, and are therefore of standard sizes, and interchangeable.

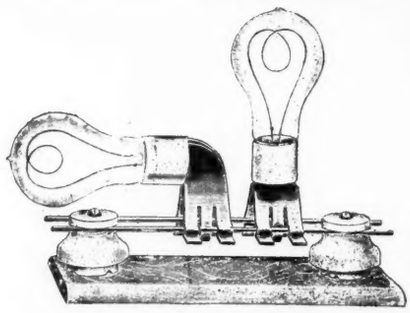


Union Arc Lamp.

The sole selling agents for the United Kingdom and the Colonies are the Union Electric Company, Limited, of 151, Queen Victoria Street, E.C.

Electrical Illuminations.

An ingenious device for electrical illuminations is being introduced by Messrs. Falk, Stadelmann & Co., Ltd., of 83, 85, and 87, Farringdon Road, E.C. The "Cremorne" system, as it is called, will be readily understood from the following figure, which shows lamps in two different positions. The conductors, it will be seen, are stout galvanized iron or copper wires, held in porcelain insulators at intervals of about 18 in.; the insulators are usually screwed on wooden battens, about 2 × ¾ in., which are cut to suit the pattern desired, or the shape of the building to be illuminated, and the wires are placed in position afterwards. The lamps are then clipped on by means of their special spring terminals, as close together as may be desired. The battens can be stocked ready fitted in suitable lengths, and can be used to form large letters, lines, and patterns of every description. The system is in the highest degree weather-proof, owing to the absence of all organic matter from the neighbourhood of the conductors. The labour cost



Electrical Illuminations.

of installation is, of course, extremely small; the materials are also inexpensive, and can be used repeatedly, and the rapidity with which work can be carried out on this system is a very strong point in its favour. The system was used at the Paris Exhibition in 1900, over 80,000 lamps being in constant use with successful results.

American Electrical Novelties.

In their new list of "Ever Ready" portable electric lamps, the American Electrical Novelties and Manufacturing Company, 102, Charing Cross Road, W.C., show a number of things in the way of novelties. The "Ever Ready" dry battery is employed for these. We illustrate two of the special lines. One is a compact pocket lighting set for dentists. The lamp is held at the forehead of the operator by means of a strap, so that both hands are free. The latest design of lamp bulb is slightly different from the illustration; the new fitting is of glass all the way up instead of having the holder arrangement as shown. This has been adopted for sanitary reasons. At the end of the bulb there is a convex lens, and an excellent light is stated to be obtained. The sets are made in two sizes, 11A for ½ volt, and 11B for 5½ volts.

The "Ever Ready" electric interior searchlight is expressly made for the purpose of examining interiors where the light from an ordinary lamp would not penetrate. For lighting up the interior

Electric Interior Searchlight.

of a barrel, or exploring the dark recesses of complicated machinery it is especially suited. The rod is of highly polished nickel, and the bulb is securely protected by a guard so that it can be poked into out-of-the-way corners without injury to itself, or danger of fire

Portable Dental Light.

The lamp is lit by pressing the ring upon the band as shown. There is a cap at the lower end which screws off to admit of the dry battery being replaced when required.

The Jandus Arc Lamp.

The principal features claimed for the Jandus continuous current lamp are:—The maximum possible burning hours, high arc voltage, simple direct-acting mechanism, complete enclosure in iron, entire absence of smoke, wheels, clockwork or flexible cords. It is said to be the only arc lamp incorporating these features, and the only lamp that can be trimmed without lowering the outer globe.

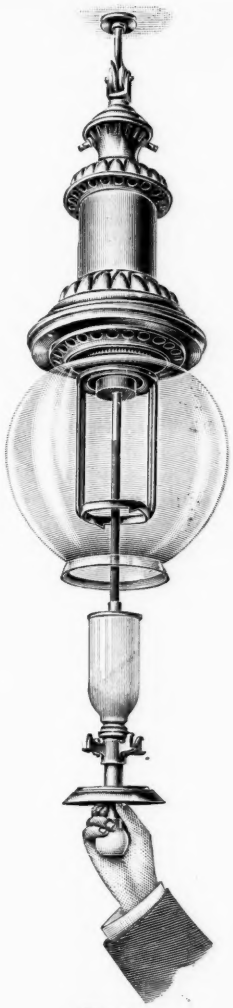


Fig. 1.

In order to embody the qualities mentioned above in one lamp, a radical departure from existing types was necessary, and an inspection of the general appearance and details of construction will show a bold handling of the problem. Only one form of construction satisfied all requirements, and that was to have the mechanism concentric with the central stem.

The customary carbon rod has been dispensed with, and a loose sheath or detachable holder substituted. Both the holder and carbon feed through the clutch mechanism, consisting of three radially disposed rings, which at once centre and clutch the positive electrode.

The evenness of the feed is remarkable, even when new, but the great advantage lies in the smoothness of feeding when the parts are dirty, no difference being noticed under conditions that would totally jam any type of gearing.

The important feature of the lamp is the double enclosure of the arc. The outer globe is airtight at all points except at the bottom, where a hand-hole is provided large enough to permit of cleaning the globe and trimming the lamp. This hand-hole is closed by a detachable pan allowing free egress, but limited ingress, to air. The lamp may be trimmed and the globe cleaned through this opening without disturbing any airtight joints.

The upper opening of this globe is secured to the negative carbon frame, and is made airtight by asbestos gaskets, the globe and frame combination screwing on to the body of the lamp. The negative frame and inner globe-carrier are nickel-plated, giving a pleasing finish and preventing rust.

Within this outer globe, and immediately surrounding the arc, is a small globe into which the carbons are fed. The inner globe acts as a high temperature chamber, while the outer globe provides a storage space for the products of the combustion which takes place in the inner globe. On the formation of an arc, the air enclosed within the small globe is heated and rarified, the surplus air escaping into the outer globe and displacing a corresponding amount of cold air, which finds vent through the valve at the bottom. The oxygen in the small globe is soon consumed by combustion to carbon monoxide, and this, with the chemically inert nitrogen, accumulates in the large globe and surrounds the inner

Fig. 2.

arc-enclosing chamber, preventing the access of air to the carbon points. This accumulation of warm inert gases in the upper portion of the outer globe, forms a reservoir from which the inner globe may draw in gas when necessary. as, owing to the slight variations of pressure in nearly all electrical circuits, small variations in the temperature of the inner globe, and consequently in the density of the gases, are continually occurring.

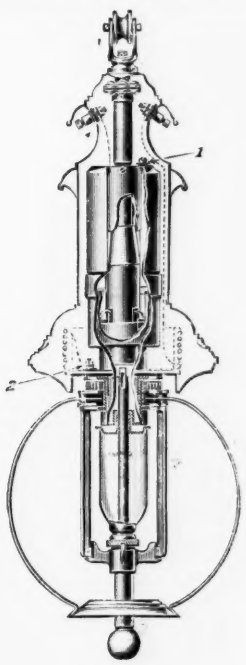


Fig. 3.

The inner globe and covering cap are specially shaped in order that the fine dust produced by the carbons may be deposited upon the cap, so that the discolouration of the globe, even with inferior carbons, is greatly diminished.

By this method of enclosure, half-inch carbons taking four amperes at 100 volts will burn about 200 hours, without retrimming and without material discolouration of the small globe.

The lower part of the negative frame is in the shape of a ring, large enough to admit a spider-shaped casting, the arms of which

register with slots in the ring; the casting, when turned to the right, locks the negative carbon holder within the negative frame, and brings the lower carbon holder into electrical connection with the negative terminal. A porcelain handle is fitted on the lower carbon holder, upon which a spring device is mounted to hold the pan yieldingly against the lower flared opening of the globe.

The method of trimming may be seen from fig. 1, which also shows the general appearance of the continuous current lamp.

A longitudinal hole in the lower carbon holder admits the negative carbon. A metal cap through which the positive carbon passes freely is placed over the top of the small globe, and acts as a cut-out when the carbons have been consumed to a predetermined point.

An artistic and handsome finish is given to the lamp by the case, which is made from thick relieved brass or copper, well nickelled for indoor use, or japanned for outside and exposed positions.

The mechanism contains one moving part only, *i.e.*, the armature, to which the dash is attached. The armature has a dead weight of nearly 4 lbs., and the diameter of the dashpot is 3½ in. These details are both unique, and the great weight of the armature, with

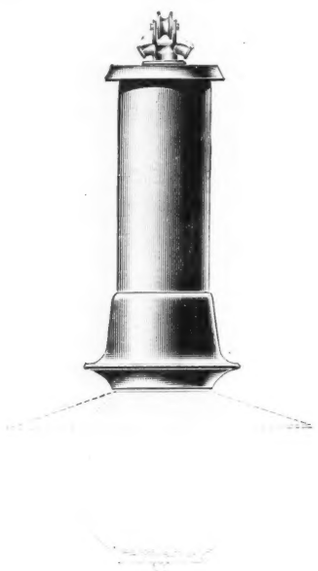


Fig 4

the large dashpot, forms a controlling arrangement not liable to derangement by dirt or dust, and very powerful and certain in action.

The current is fed to the upper carbon by patent gravity brush rings, giving a smooth and frictionless contact and avoiding the use of flexible cords.

The lamps for working in series are provided with a shunt coil of exceedingly high resistance, 600 ω. The series coil is, in addition, provided with a series of loops for adjusting the lamps, thus forming a positive connection that cannot possibly get out of order and avoiding the use of spiral springs or light counter-weights.

The general arrangement of the continuous current lamp is shown in fig. 2, while fig. 3 shows a sectional view, from which it will be seen that the whole of the mechanism is enclosed, completely air-tight, by a machined iron casing.

The whole of the work is turned to gauges, rendering the parts perfectly interchangeable. Spare parts can thus be kept in stock that will fit any lamp.

The resistances which are used with these lamps are the outcome of a lengthened experience, and are sufficiently large to bear a heavy overload, while they give a high insulation resistance under all conditions. They are completely enclosed in metal casings to render them fireproof, and are made to insurance companies' requirements.

The power circuit lamp is shown by figs. 4 and 5. This lamp contains the same carbon feeding mechanism as the standard continuous current lamp, and has in addition an automatic cut-out, which in case of the extinction of the lamp, cuts the lamp out of circuit, and throws in the substitutional re-istance seen in the top of the lamp casing.

This lamp has the Jandus patent swivel suspension, enabling the leads to be carried through piping. This suspension is in use on circuits having pressures up to 3,000 volts.

It should be noticed that the cut-out is distinct from the rest of the mechanism of the lamp, and is energised by its own solenoid. Many so-called cut-outs operate only by the mechanism of the lamp, and should this jam through dirt or any cause, the cut-out would be inoperative.

The standard lamps are largely used for street lighting and other installations, burning in series on 500 or 1,000 volts, a special automatic cut-out and containing box being used. This, like all the Jandus cut-outs, is perfectly automatic, re-setting itself when the circuit is switched off, and avoiding possible mishaps due to the carelessness of the lamp trimmer.

Another form of automatic cut-out is in use where incandescent lamps are on during part of the lighting hours. This, on the failure of the arc, automatically cuts out the arc lamp and throws an equivalent substitutional resistance into the arc lamp circuit, lighting up the incandescent lamps on the post at which the lamp has failed.

Other forms are also made for automatically switching out or in incandescent or arc lamps, and the company stock a standard series of panels in slate or marble for use in lamp-posts or similar situations, and a series of switch-boxes for use in railway stations, ironworks, foundries, dockyards, &c.

A cheaper form of lamp is the "Commercial" type. The mechanism in this is identical and interchangeable with that of the "Standard" lamp, the difference being that the lamp is designed for those requiring a cheap lamp that can compete with the foreign-made lamps sometimes offered for sale.

The case is less ornamental in appearance than the "Standard" lamp, and the trimming arrangements are reduced to a maximum of simplicity. To trim the lamp, the outer globe is released from a bayonet catch, and two turns of the frame holding the inner globe allow the inner globe and carbons to be lifted out, cleaned and replaced.

The Jandus alternating lamp has several unique features. It embodies the trimming device of the standard continuous current lamp, enabling it to be trimmed without removing the outer globe.

The whole of the mechanism is enclosed in a dust-proof metal casing, and this lamp, by special arrangements, is rendered absolutely noiseless. The burning life is from 80 to 90 hours with one pair of carbons. Interchangeability of parts is, as usual, a strong feature.

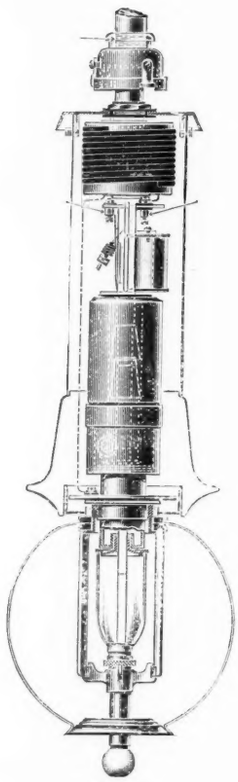


Fig. 5.

An important feature in this design is that absolutely the same lamp, without any adjustment, will burn on any frequency from 40 to 120 periods per second, and upon any voltage from 60 to 2,000 volts, the necessary adjustments being entirely effected in a line of standard interchangeable transformers and choking coils.

Any lamp will burn in series, multiple series, or parallel, with any other lamp without special adjustment.

The main features of the mechanism consist of two solenoids energising a laminated iron core. This, by means of accurate pulleys, lifts a clutch identical with that of the standard continuous current lamp.

Transformers and chokers are kept in stock enabling the lamps to burn singly direct off the transformer, transforming from 1,000 or 2,000 volts to a lamp voltage of 80 volts, or parallel choking coils regulating the voltage of the lamps, any number in series, up to 25, or 2,000 volts. The lamp current with this latter arrangement is 7 amperes, the total amount flowing through transformer and lamp being 8 amperes.

Should the circuit of the lamp be broken, the voltage across the transformer rises to 100 volts. Half the lamps may, therefore, be

cut out of circuit without affecting the steady burning of the remainder, or, on an emergency, two thirds may be cut out, the remaining third still burning fairly well.

Marble panels are kept in stock on which the necessary fuses, transformers and switches are mounted for placing in lamp-post bases or similar situations in street lighting or dockyard work. The lamps being interchangeable, in order to make periodical cleanings or overhaulings of the lamps, it is only necessary to remove the lamp from its suspension and substitute a spare lamp, the apparatus in the lamp-post base operating the new lamp equally well with the old, and avoiding any necessity for re-adjustment.

The Edison Incandescent Lamp.

In their latest trade circular, the British Thomson-Houston Company, Limited (Rugby), bring before the notice of firms engaged in the electric lighting business the merits of the Edison incandescent lamps. The many complex processes through which so apparently simple a device has to pass are referred to, and the necessity for experience and systematic inspection and testing is emphasised. The Edison lamps are stated to undergo 50 constructive operations and 40 separate tests before being handed over to the purchaser. It is stated that correct and uniform rating in c.p. by accurate standard has always been one of the great features of this make of lamp. Among the newest processes employed for improving the quality is the method of chemical exhaustion. This is claimed to overcome many of the difficulties in the exhaustion of high c.p. lamps, to reduce blackening and maintain the c.p., and materially improve the quality of the average lamp. The annual production of the Edison lamp at present is over 15,000,000. Figures are quoted proving what is pretty well known to the electrical engineer, but not often enough acted up to by the consumer—however anxious he may be to keep his current account low—viz., that there is no economy in continuing lamps in use after 600 hours. To scrap them after they commence to become dim is the right thing. Long life ought not to be the sole concern when selecting an incandescent lamp. The latest designs of low and high voltage types are described in the pamphlet before us. For tramway and railway lighting, lamps with unanchored filaments, while enabling the shock and vibration to be withstood, have such short stiff filaments that the lighting capacity is limited; if the filament be anchored to the inside of the bulb, the filament may be held too rigidly and the shock be disastrous to it. The Edison lamp employs a metal anchor which is firmly connected to the stem or inside part of the lamp, the filament being so held as to check vibration and keep it within proper limits, rather than to entirely prevent it. The whole filament vibrates together, and the danger of the branches interlocking and short-circuiting is claimed to be practically non-existent. The traction lamps are made for 500, 550 and 600-volt circuits. Accompanying these notes will be seen some specimens of artistic arrangement of Edison lamps for illumination purposes.

Fig. 1.

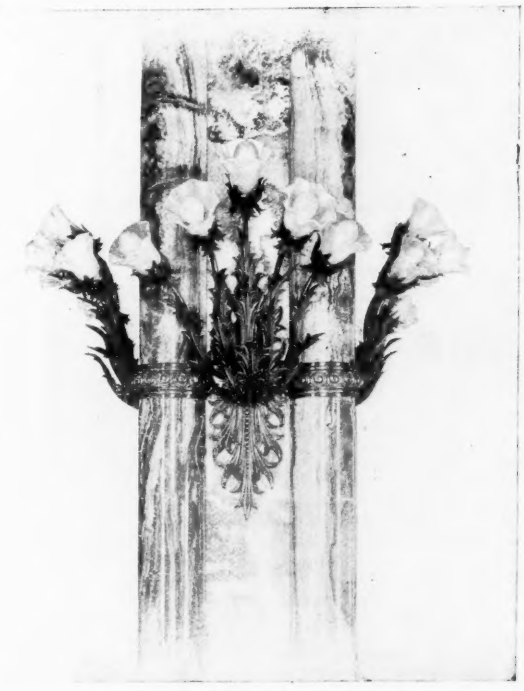


Fig. 2.—Artistic Column Effect.

Steel Conduits.

The Simplex Steel Conduit Company, Limited, of London (20, Bucklersbury), have issued this month some supplementary trade sheets in connection with their 1901 price lists. Some particulars are given of several rather important additions and improvements to the system. Fig. 1 shows the Simplex turn switch box (in plan without cover), which can be advantageously employed

Fig. 1.—Simplex Turn Switch Box.

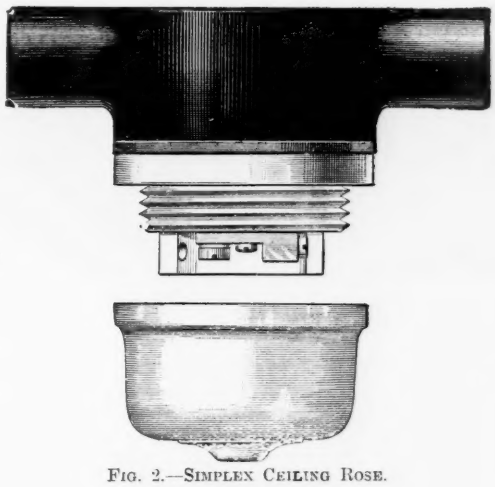


Fig. 2.—Simplex Ceiling Rose.

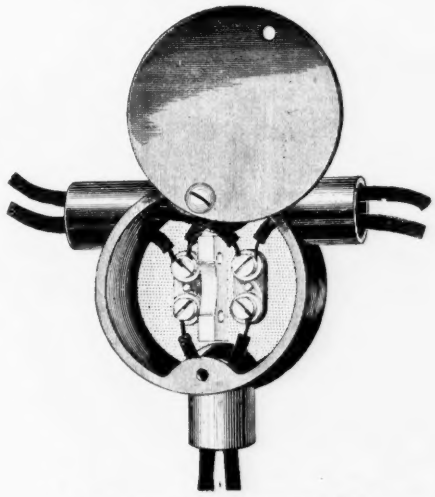
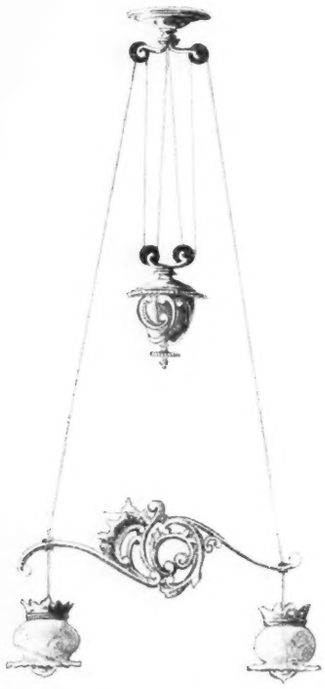


Fig. 3.—Simplex T Connection Box.

in conjunction with the Simplex ceiling rose. The latter is shown in fig. 2. It has solid terminal pieces, cut from special section brass, and recessed porcelain backs, suitable for "looping-in" wiring for three-ampere circuits. Fig. 3 shows the company's **T**-connection box.

Pendant Fittings.

Some neat and artistic pendant fittings have recently been put on the market by Messrs. W. M'Geoch & Co., Ltd., of 108, Argyle Street, Glasgow. One of our figures shows a wrought-metal and glass hall lantern suspended by a chain; another illustrates a double pendant with counter-balance weight, the two lamps being kept



Double Pendant.

Hall Lantern.

apart by an elegant distance piece of art metal work. A large variety of similar fittings and of general electrical accessories were on view at the Glasgow Exhibition, all made at the company's works in Birmingham and London.

A New Electric Gas Lighter.

Messrs. Nehmer Bros., of 222A, City Road, London, E.C., have recently patented a gas lighter called the "Sparkler," which, we think, to judge by its simplicity, will be a boon to the general public, and especially to warehouse and factory owners. Portable electric gas lighters have been in existence for some 30 years, but many of them have required constantly recharging and repairing. In order to avoid these difficult and costly repairs, Messrs. Nehmer Bros. have not only done away with the complicated pusher, speed wheel, and ratchet mechanism, but also with the tin and copper foil connections. In addition, they have altered the arrangements of the static system, and discarded the neutralising bridge. This new departure from the usual type of influence machines has the advantage that a very brief rotation of the inner cylinder generates enough sparks to light the gas. The friction is almost *nil*, and in consequence of this the lifetime of the apparatus is considerably increased.

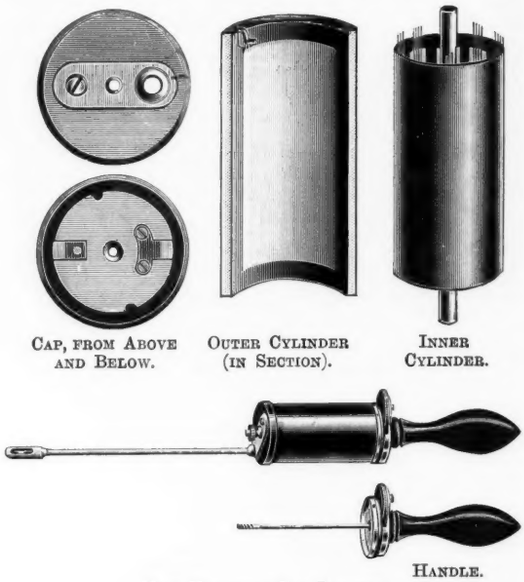
When taken to pieces, the new lighter consists really only of four parts, viz., the handle or body, the inner cylinder, the outer cylinder (in section), and the cap with its spire.

The body consists of a handle, to which a friction wheel is fastened; there is a long steel rod right through its centre, which forms the spindle, and serves as support for the other three parts.

The inner or rotating cylinder is made of vulcanite. Lengthwise to its inner surface are fastened eight strips of tinfoil, with fine metal wire brushes attached to the end of each. The axle of this cylinder is a brass tube, with a shaft cushion at each end; this fits on the spindle, and is set into rotation by the friction wheel.

The outer is a larger stationary vulcanite cylinder, which fits over the other one. To its inner surface are fastened two field plates, provided with two wire extensions, against which the brushes strike in rotation, and so replenish the charges on the field plates. The remaining part is a vulcanite cap, which fits on the outer cylinder, and is screwed down by a nut. It supports the spire on one side, and has fastened to the other side two solid metal blocks, which are connected with the sparking points, and fixed in a diametrical position in such a way, that the brushes strike them in rotation, and convey the electricity to the top of the spire.

We do not see how this gas lighter can in any way fail to continually work properly, as the charge is generated by the person



Cap, from Above and Below. Outer Cylinder (in Section). Inner Cylinder. Handle.

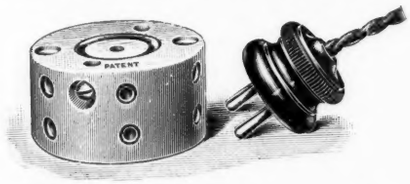
New Electric Gas Lighter.

using the lighter without any intervening mechanism. All the connections are such as to last almost for ever, and wire brushes of the kind described have stood the test for many years.

We must congratulate Messrs. Nehmer Bros. upon the ingenuity and skill with which they have constructed their "Sparkler," and we hope that they will reap the benefit of their invention in the future.

The "Turret" Multiple Distributor.

We have before us a sample of the "Turret" multiple distributor, which is shown in our two illustrations, and is being sold by Mr. A. P. Lundberg, Liverpool Road, Islington, N. This has been



"Turret" Distributor for Dining Table.

designed to form a compact, simple and neat distributing centre, for use where several circuits have to be taken off for various purposes, and will be found useful for dining table lighting, showrooms, shop window lighting, &c., enabling the whole apparatus to be easily

Ordinary "Turret" Distributor.

removable if necessary, or re-arranged to suit requirements. The base is of porcelain, the arrangement of metal contact tubes radiating from its centre as shown in the illustration; the two groups are well separated from each other by porcelain. The

maximum number of ways which can be arranged is six. The plugs used with it are of the "Dot" gauge, all of which plugs are now supplied (similar to the "Universal" gauge of plug) with excellent provision for cord grip without increase of size. When fixed on the underside of dining tables, the leading-in wires from a floor connection may most conveniently be passed through the roof of the cover, as shown in one of our figures. Fitted with a fibre disc and contact pins, it forms a convenient distributing centre for a floor connection.

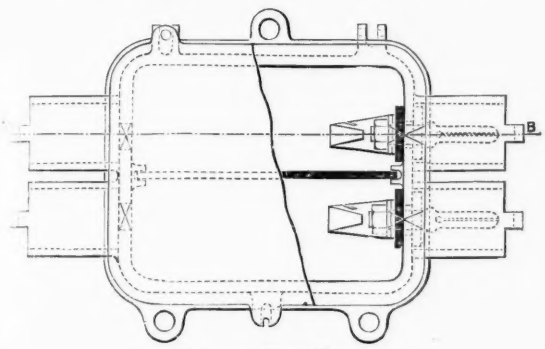
For table use, the "Turret" can be fitted on a wood block, and the leading-in wires arranged to enter the block from the side. It can also conveniently be adapted for various other requirements.

Gas-Tight Fuse Box.

A new gas-tight fuse or junction box is being placed on the market by the Electrical Trades Supply, Limited (Cornwall Street, Birmingham). It is intended mainly for use in mining work, and therefore is specially designed for rough wear, and we understand it to be the outcome of many years' experience of electrical work as applied to mining. The following are some of the advantages which are claimed for the device, viz.:—

1. That all connections with the cables, though made with the usual spring plugs, are *outside* the fuse chamber, and consequently cannot be damaged by the flame; also the sockets fitting on the same being heavily insulated, can be handled with perfect safety when it is necessary to disconnect the box in order to replace a fuse.

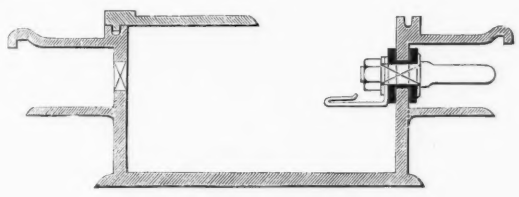
2. The pins, nuts, screws, and washers usually adopted for securing the fuse



Plan of Fuse Box.

which are a frequent source of trouble and annoyance, are entirely dispensed with by adopting the specially designed spring clip. The fuse wire being drawn between the two faces of the clip, a perfect mechanical and electrical contact is always ensured. Also a sufficiently long break being allowed, any possibility of the clip being damaged by the flame is reduced to a minimum.

3. The above arrangement also enables the fuse to be replaced in about one-third the time usually taken; this, in cases where the fuse is frequently blown (as with coal-cutting machines, where 20 or 30 replacements in one shift are often necessary), is a great saving of time, and will commend itself specially to users of coal-cutting machines.



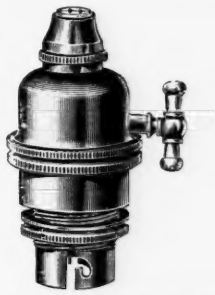
Section of Fuse Box.

4. It will be further seen on reference to the illustration that the only part actually *inside* the box are the fuse itself and its necessary fastenings, there being no slate or porcelain bases to crack or deteriorate with excessive heat. This, again, is of great importance as, owing to the absence of the necessary metal screws, &c., for securing these in position, the insulation of the box is kept very high and all expensive renewals of the same are done away with.

The box has been in satisfactory use for the past 18 months in connection with coal-cutting machines, and pumping and hauling plants.

New Switch Lampholder.

Messrs. Sperryn & Co., Limited, of Hospital Street Works, Birmingham, have recently perfected a very clever switch lampholder, which they consider to be the best ever brought out. We have examined a sample holder, and certainly we have never seen a better one; the parts of the switch are modelled on the pattern of the "Sperrynwood" tumbler switch, which we recently referred to, and practically the same description applies. The usual fault of switch holders—namely, the liability to short circuit—is entirely overcome by excluding the leads altogether from the switch chamber, and by providing a practically unbroken porcelain barrier between them throughout their whole length. A long break is provided, and the handle is insulated from the electrical parts, while the switch gear is entirely surrounded by porcelain—or rather by the special ware employed by Messrs. Sperryn. We should have no hesitation in



Sperryn Switch Lampholder.

installing this holder on a 240-volt circuit, and we see no reason why fire insurance companies should object to their use.

Heating and Lighting Appliances of the G.E.C.

A large range of cooking and heating appliances is being stocked by the General Electric Company (1900), Limited, of Queen Victoria Street, E.C.; some of these are illustrated herewith. Figs. 1 and 2 show electrical soldering bits, of which fig. 1 is fitted

Fig. 1.—Electrical Soldering Iron.

with the usual form of heating device, while fig. 2 is heated with an electric arc. The former consists of a copper body, surrounded by resistance wires, which are protected by a metal shield. The connecting wires are led out through the handle. The bit is screwed into the body and heated by conduction; it can be removed

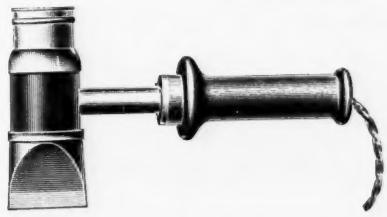


Fig. 2.—Electric Arc Soldering Iron.

without disturbing the electrical connections. These irons are made in 2 and 3 lb. sizes, taking 1 to 2 amperes at 100 volts.

The other weighs 3 lbs. upwards, and takes from 4 to 6 amperes at 45 volts, with the normal resistance in series; in this case the copper bit is the positive and the carbon the negative electrode.

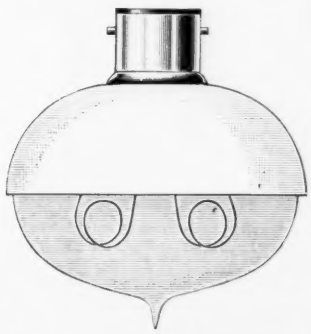


Fig. 5.—Robertson "Sunshine" Lamp.

The carbon is put into a spring holder, the current switched on, and a knob pressed and released. This strikes the arc, which is maintained for half an hour, when the arc must be renewed. Ordinary arc lamp carbons are used. Fig. 3 shows an electric kettle on an ornamental stand. Fig. 4 is a view of the "Apollo" radiator, which takes an input of 250 watts per lamp.

These, of course, represent only a selection from the numerous

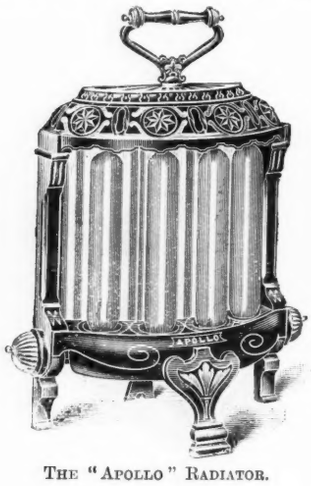
cooking utensils, heaters, &c., comprised within the company's extensive *repertoire*.

The new Robertson "Sunshine" lamp, which has been specially designed for the lighting of streets with glow lamps, also calls for attention. This lamp has a detachable opal glass reflector, which fits over the upper half of the lamp, and can be used indefinitely

G.E.C. Electric Kettle on Stand.

with new lamps. The lamps have two stiff filaments in series for high-voltage circuits, with the special object of providing against vibration. The intention is to use two of these lamps facing opposite directions, in the existing gas lanterns if desired.

Our readers will remember that in a recent issue we described and illustrated a variety of fittings selected from the splendid display



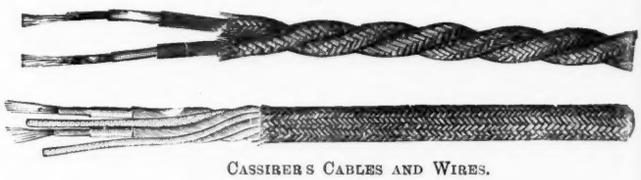
The "Apollo" Radiator.

exhibited in the company's showrooms; we need not, therefore, reproduce them here. The "Angold" enclosed arc lamp also, which we recently described, is now being supplied for alternating current circuits of all ordinary frequencies, together with suitable balancing and economy coils for 100 and 200-volt circuits.

A special feature of the G.E.C. stuff is that it is all of British manufacture.

Vulcanised Rubber Cables and Wires.

The extensive cable and rubber works of Dr. Cassirer & Co. are busily engaged supplying the demands for their vulcanised cables. The speciality they manufacture is minimum resistance 600 megohm grade, high conductivity copper wire insulated with pure and vulcanised india-rubber, taped, the whole vulcanised together, then braided and compounded. We understand that every coil is tested after 24 hours' immersion in water 60° F., and after one minute's electrification. The whole plant for manufacturing this cable is of English make, and of the latest and most improved designs. The greatest care is exercised in securing the best Para rubber obtainable in the English markets. The Para rubber is mostly bought ex Liverpool Docks in original lumbs as gained from the rubber trees. It requires a good deal of special treatment before it is sufficiently purified to be suitable for the manufacture of cables. The whole process of preparing the rubber is done at Dr. Cassirer & Co.'s works by the most modern labour-saving machinery. Messrs. G. Straus & Co., Limited, 21, Upper Thames Street, London, E.C., are the wholesale suppliers of Dr. Cassirer's cables for England and Colonies. They keep a large and well assorted stock for immediate delivery.



Cassirer's Cables and Wires.

Vulcanised flexible cord is another item which is largely dealt in by the same manufacturers. For the silk covering of these flexibles the best Miland silk is used, which, besides being non-fading, is of glossy and pleasing appearance in tone of colour. No better proof of the satisfactory quality of Dr. Cassirer & Co.'s cables and wires can be offered than the remarkable increase of sales during the past few years in all parts of the electrical world.

A Convenient Fitting.

One great feature of electric lighting is the ease with which lamps can be moved from one position to another and the light directed to the exact spot where it is required. Messrs. Charles Joyner and Co., of Icknield Square, Birmingham, have for many years turned their attention to developing various devices for adjusting pendant lights. They were among the very first in the field with the ordinary shot-loaded counterweight and pulley arrangement, now universal, but they long ago recognised that this left much to be desired—at any rate, from the artistic point of view. The method they have now perfected does away altogether with counterweights, which, with large fittings, throw such a heavy strain on ceiling fixtures and involve a multiplicity of pulleys and wires. It is simply

Spring Counterbalance.

to oppose the weight of the fitting by the pull of a spring which causes a drum or reel to revolve. The accompanying illustration shows the device in its simplest form, as used for office work, but Messrs. Chas. Joyner & Co. are now making this fitting up in a variety of sizes and designs, some of these highly ornamented and finished, for use with dining room table shades, &c. As a result of long experience they have found that the prejudice against the use of springs in such fittings is unwarranted. For instance, the action of their compensating blocks (for taking up the slack in arc lamp leads) depends upon the opposing of the force of two springs. These blocks have been long in use under every variety of condition—some of the lamps being fixed in most exposed positions—yet we understand that the failure of a spring is most rare.

New Designs of Electric Fittings.

A new company, to be known as the Electrical Fittings Company, are shortly opening showrooms at 38, Conduit Street, New Bond Street, W., under the management of Mr. S. B. Marshall, late of the

General Electric Company. The company only supply the trade, and the showrooms are for the exclusive benefit of the trade and their clients. We place before our readers a few specimens of the

Small Bracket Fitting.

new styles of fittings which they are introducing, and for which orders are already coming in. One of the illustrations shown is a design of billiard fitting in hammered brass with *repoussé* band.

Three-Light Drawing Room Fitting.

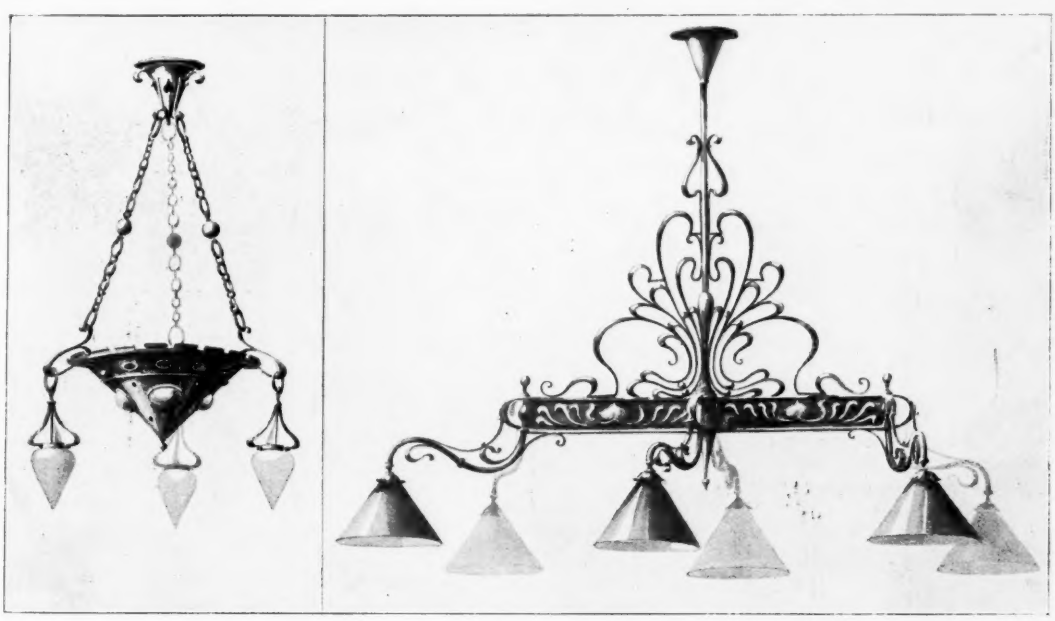
Another illustration represents a dining-room fitting in dull polished copper for three pendant lights and three lights inside metal bowl. The latter give a soft reflected light from the ceiling. The oval medallions on the top part of the bowl are of brilliant green translucent enamel, the raised parts on lower part of bowl being of glass. The whole of this fitting is hand hammered, and shows the hammer marks.

A drawing of three-light electrolier of quite a new style, which we think will appeal to the artistic eye, appears above. This design is executed in oxydised silver, the raised parts of metal being polished by hand. The small bracket fitting which we show is of cast-brass coloured natural bronze, suitable for a dining-room or library.

I.E.G.L. Street Lighting.

With commendable consistency the Improved Electric Glow Lamp Co. continue their efforts to perfect their system of street lighting with arc and glow lamps. Naturally enough, the latter is their strong point, though the company make an excellent arc lamp for public lighting, and are preparing new developments in this direction which will certainly attract attention. We recently paid a visit to their showrooms for the purpose of examining their apparatus, and were greatly interested in the results which they have obtained. The advantages of the silvered conical lamps which form their chief speciality were unintentionally demonstrated by Prof. Rowland in his paper read before the American Institute of Electrical Engineers a short time ago, when he pointed out that the lamp which is of the greatest effective value is not the one with

Fig. 1.—Converted Gas Lantern with Improved Glow Lamps.



Dining Room Fitting.

Billiard Table Fitting.

equal luminosity in all directions, but the lamp which concentrates its rays below the horizontal plane; for the maximum illumination is required, in most cases, not on the walls and ceiling, but on objects which are but a few feet from the floor.

FIG. 2.—COMBINED SWITCH AND FUSE BOX FOR LAMP-POST.

This is the *raison d'être* of the reflector lamp, which by slow and almost imperceptible degrees has been brought to a high state of perfection. For example, one of these lamps, selected at random, gave over 80 C.P. towards the tip with the aid of the reflector, but when denuded of the silver was found to give less than 16 C.P.

No actual increase of light emission is claimed for the lamps; the point is that the rays are directed in the most useful path. For instance, in street lighting it is desirable to illuminate not merely

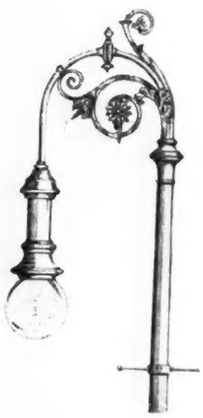


FIG. 3. FIG. 4.

I.E G.L. STREET LIGHTING FITTINGS.

the area adjacent to the lamp post, but also the area midway between two posts, and this object is attained, as shown in the foregoing figure of a converted gas lantern, by fixing the lamps at such an angle as to throw their light towards adjoining posts; the rays from two adjacent lamps, overlapping midway between them, combine to produce a powerful and fairly uniform illumination from post to post. This object cannot be attained unless the solid angle subtended by the reflector at the filament is very large, and the system of combining the reflector with the lamp itself enables this to be accomplished without using reflectors of excessive dimensions; moreover, the silver can never become tarnished, as it is in actual contact with the glass.

A variety of fittings has been designed in accordance with thi

principle, two of which are shown in our figures, and to render the system homogeneous, a large range of fuse and switch boxes, &c. has been got out. One of these is shown in fig. 2, which illustrates a combined switch and d.p. fuse box, entirely weather proof The fuses are of a special cartridge type, which absolutely prevent the formation of an arc; we have seen them applied as a dead short across 200-volt mains, with quite satisfactory results. Moreover, the box is lined with asbestos. Fig 5 shows another pattern.

A series of junction boxes for concentric cables, under the Hammond patent, and of single-main boxes, with Harrison's patent connectors, form part of the system. The latter are illustrated

FIG. 5 —SWITCH AND FUSE BOX.

FIG. 6.—I E.G.L. ARC LAMP SUSPENSION GEAR.

herewith, and the figures practically explain themselves. The connector is extremely neat, all the parts being clamped together by a single screw, while they are at the same time enabled to adjust themselves to a suitable bedding.

The open arc lamp made by the company is of the focussing brake-wheel type, with very strong and simple mechanism; this is used in conjunction with a special suspension gear, which we illustrate in fig. 6. The lamp is hung in the bight of a cord, so that

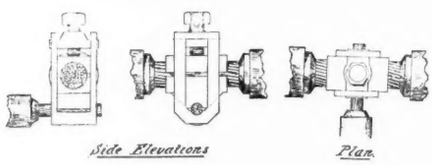


FIG. 7.—HARRISON'S PATENT CONNECTORS.

it cannot spin, and the contacts are of the jaw type. When the lamp is hauled up, two spring catches engage with a cross-bar in the hood and take the weight of the lamp. To lower the lamp, it is first hauled still higher; two links then engage with the bar, and hold off the catches when the lamp is lowered. A patent safety winch is used in conjunction with the gear, of which the construction is such that it is impossible to let

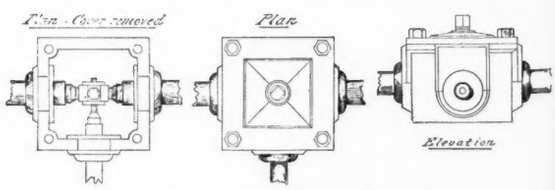


FIG. 8.—I.E.G.L. SINGLE-MAIN JUNCTION BOX.

the lamp run down quickly, even when the handle is suddenly released or pulled off. This object is secured by means of a spring pawl inside the winch barrel, which is always engaged with the teeth of a ratchet wheel, except when pressure is applied to the handle. We tried to drop the lamp by various means, but the winch always acted. The top of the lamp is received by a cylindrical guide attached to the hood, but not shown in the figure, so that the contacts cannot be missed, nor can the lamp swing so as to cause

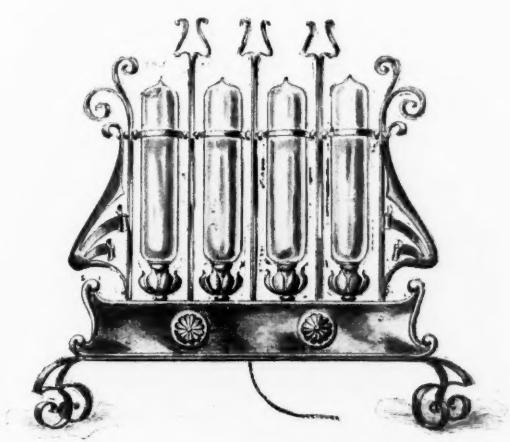
sparking. Fig. 3 shows one of the lamps suspended from a column bracket.

A visit to the company's offices will provide much of interest to engineers concerned in street lighting.

Hands, Limited's, Electric Light and Heating Fittings.

Messrs. Hands, Limited, hold a good stock of art metal electric lighting fittings on show at 30, Snow Hill, E.C. A number of their

Extension Floor Lamp.



Hands' Electric Radiators.

lists of latest hand-hammered fittings designs, in which they are exceedingly busy just now, are before us. We have selected therefrom a couple of designs, one of a two-light standard suitable for banks, offices, and mansions, and an extension floor lamp, which is supplied in finished gilt, Florentine bronze, antique brass, or

Two-Light Standard.

oxydised silver, as required. We also illustrate one of their new electric radiators, which are made in various finishes. Their artistic appearance and effective heating qualities are claimed as special features.

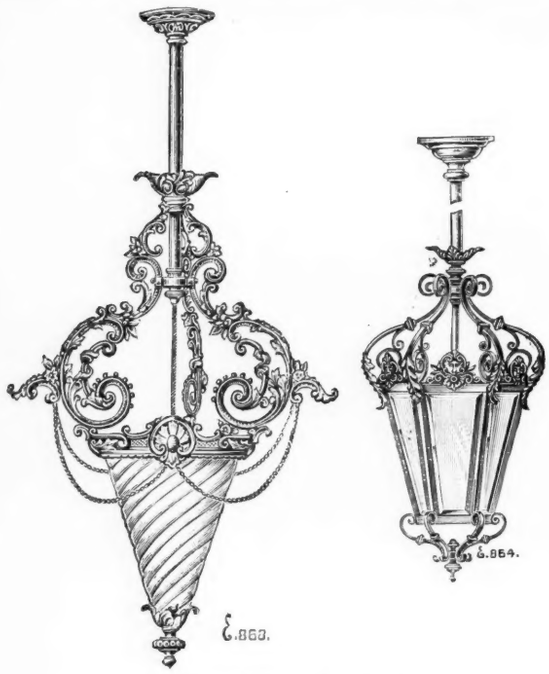
Evered's Fittings.

At the extensive premises of Messrs. Evered & Co., Ltd., 27—35, Drury Lane, London, W.C., there is a very large stock of electric light

Evered's Outside Light Fitting.

fittings, open to the inspection of the trade. Everything there shown has been manufactured at the firm's Surrey works at Smethwick, and in the very varied assortment the trade and their customers whom

they may take have ample scope for choice. The firm are brassfounders, and carry on a very large business in many other lines besides electric fittings, but the latter branch is rapidly becoming one of the most important, and judging from the large amount of space devoted



Evered's Pendant Fittings.

to it at the showrooms it is responsible for a pretty considerable turn-over in the course of the year. The last issue of the handsomely bound catalogue contains numerous pleasing designs of all kinds of fittings, such as pendants, lanterns, brackets, electroliers,

Hall Lantern.

standards, and ceiling fittings, with artistic glass or silk shades as the case may be. There are brass, hammered iron, French and antique fittings, and oxydised silver is very much in evidence just now. One room is a dark-room for showing the fittings with lamps lighted, and here there is a good collection of candelabra, class of

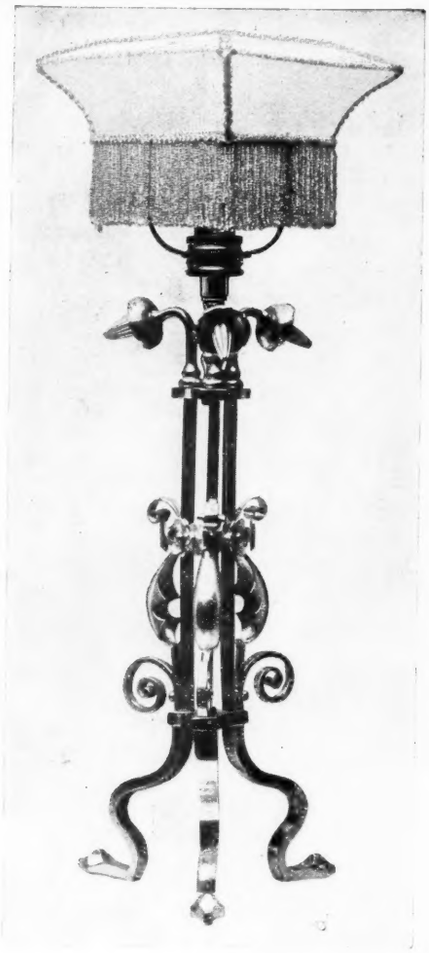
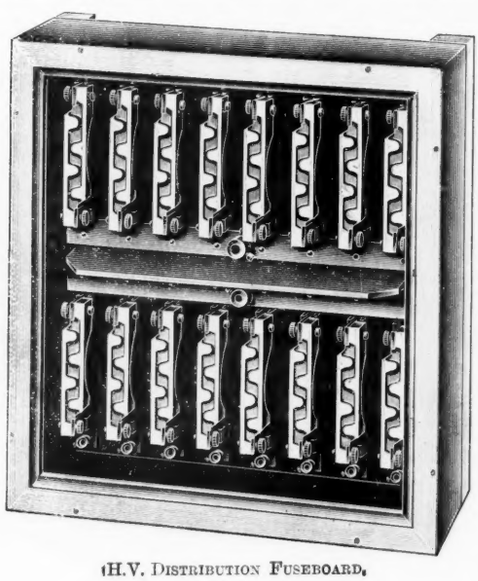


Table Standard.

fitting which is capable of doing so much toward obtaining soft but effective illumination of drawing rooms and cosy corners. We give a few illustrations of some specimens of Messrs. Evered's work.

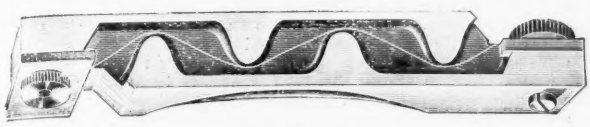
H.V. Distribution Fuseboard.

The board which we illustrate is being made by Messrs. Ward and Goldstone, of 45, Dutton Street, Strangeways, Manchester. It is claimed to possess many advantages. The fuse is visible, consequently, should a fuse blow, it can be seen which fuse has gone, without the inconvenience of having to take off at hazard the fuse



H.V. Distribution Fuseboard.

bridges till the blown fuse has been located. A fuseboard without visible fuses is considered to be little better than ordinary cut-outs. The design of the bridge permits of a 3½ in. length of fuse. The fuse wire is inserted and held in place by milled nuts, no screw-



Fuse Bridge.

driver being required. All of the insulated parts are of best English china; the metal parts are heavy enough to carry a large excess of current, and the board is easily wired. The board is mounted in real teak or oak polished cases with glazed front. Above we show full size of porcelain fuse bridge which carries with case 6 amperes at 230 volts.

Electric Heating and Cooking.

Messrs. Isenthal & Co., of 85, Mortimer Street, Cavendish Square, W., are pushing their electric heating and cooking appli-

Fig. 1.

ances, and for that purpose a new and fully illustrated catalogue is now in circulation. The appliances are all made under the

Fig. 2

Schindler-Jenny patents. Saloon and ribbed radiators, stoves, and fireplaces, numerous cooking utensils for domestic and hotel use,

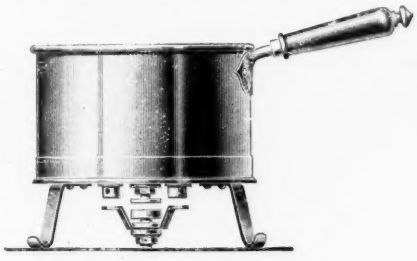


Fig. 3.

also large bakers' ovens, and a large number of general appliances are all well shown, prices being stated. In fig. 2 we give a picture of a saloon radiator of the low type with ruddy illumination. In fig. 1 will be seen three sizes of new rapid jugs. They are sold nickelled and the boilers are fitted with heating elements, both at the bottom and also around the sides up to a certain level, and, therefore, act very quickly. They must, however, always be filled up to the level of the lateral heater. The smallest size is a ¾-pint (boiling operation, five minutes), the others being 1¼ pints and 2½ pints and boiling in nine minutes. These jugs may be fitted with automatic cut-outs if desired. Fig. 4 shows an electrical soldering bit. These are supplied either hammer-shaped, point-shape, or with round edge. An automatic safety cut-out, which we illustrate in fig. 3, is devised for the protection of

Fig. 4.

any vessel to which it may be fixed from burning out when the current is on and no liquid is contained in the vessel. The device is claimed to automatically interrupt the current a very few minutes after the empty utensil has been switched on. Both the actual heating element and the receptacle proper are protected from destruction, and only the contact has to be renewed, a matter which may be attended to by the user, and which may be effected in a few seconds if a spare pin be ordered with the apparatus. Meanwhile the disconnected parts of the automat may be soldered together again by a plumber, and are then available as a new spare pin against the time when it may be required. The automatic device is applicable to any boiling or cooking apparatus.

Bertram Electrical Apparatus.

In view of the ever-recurring parrot cry of want of enterprise in the factory methods of English manufacturers, it may be interesting to describe the methods in practice in some German workshops.

We had an opportunity recently of going over the Konstruktionswerke Elektrische Apparate, Systeme Bertram, at Frankfurt—Main. This is a limited liability company, formed on the usual German lines, as described in the Electrical Review* some time ago, to manufacture and put on the market high pressure accessories designed by Mr. Bertram, an engineer who has had large experience in central station work, and whose productions are the result of practical experience, and are eminently adapted for their varying purposes.

We may here say that the high pressure switchboard and gear of the Kensington and Notting Hill Company's plant at Wood Lane were designed and constructed by Mr. Bertram when chief engineer of another firm; and Messrs. Bertram are now manufacturing the complete switchboard and gear required by the town of Jarrow.

The firm's leading lines are complete high and low pressure switchboards and gear, high pressure switch fuses, safety devices for transformers, lightning arresters, canopy switches and car fuses.

The parent factory, where all designs and pattern making are done, and a certain part of the manufacture, is situated in Frankfurt itself; new workshops are being erected in the neighbourhood, where workmen are to be specially trained, and to be transferred from time to time to the factory proper.

The drawing office differs little from the usual; it is a well-lighted room with drawing tables of the fixed type, and others which can be tilted horizontally or vertically and held at any suitable angle.

Again, in the pattern room the only noticeable feature is the entire absence of obsolete patterns. Once a design is discarded in favour of a new type the old patterns are broken up and cleared away.

To take one item—tram controllers—as typical of the system adopted throughout, all the raw material is brought to the range of tools required and passes through the various processes, arriving in finished parts at the assembling end of the shop, thus avoiding the waste of time in collecting and distributing. Such small items as screws and nuts are, of course, not dealt with in this manner, the only care being that when manufacturing in the shops the quantities are kept approximate to the progress in the manufacture of various parts. Thus, following this shop through, one sees the castings and stampings delivered in the shop and in every stage of completion until the assembling shop is reached, and the controller with its case is then ready for the test room.

Such items as ebonite, wood, and fibre parts, fall in the same category as screws, &c., and are finished in an adjacent shop.

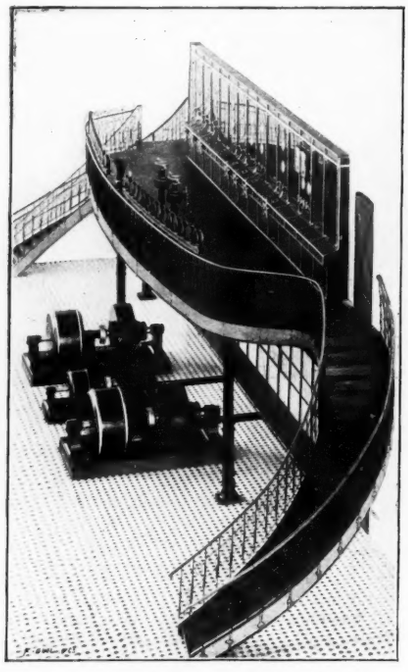
The machinery is of the latest pattern throughout, automatic in feed and action wherever possible; the foreman of each shop is a specialist in his own department, and is encouraged to suggest improvements in design or manufacture.

In the commercial part of the business, we were struck with one of the methods adopted, which might with advantage be made use of, as in the case of a tender being put in for a switchboard. In many cases a model is prepared showing in miniature

* Electrical Review, January 26th, 1900.

the full detail of the board for which the firm is tendering, and samples of any special devices appearing on the board are submitted along with the tender. At first sight this seems an over-expensive way of proceeding, but it must be borne in mind that by the panel system the same parts may be used again, even if the board as a whole were not suitable. The illustration shows the front view of a model of a large central station board; it will be noticed that it is complete even to the balancers.

The testing room has dynamos, motors and transformers giving a range of pressure up to 100,000 volts and a current up to 10,000 amperes, and is fully provided with measuring instruments of the most modern type.



Model Switchboard.

The entire policy of the firm is progressive; newest and best machinery, best and highest paid employés.

If a machine becomes obsolete, or is becoming obsolete, replace it with the latest obtainable machine; if new devices are required to suit later conditions of electrical work, design and manufacture them. Where such has been the policy here in Britain, it has met with success, and while we deprecate over hasty and ill-advised extensions, we cannot help thinking that the forward policy is too much neglected at home.

In conclusion, we may mention that the "Bertram" apparatus and specialities may be obtained from Messrs. Witting Bros., Limited, who handle the business of the firm in this country.

Stewart "Continental" Enclosed Arc Lamp.

We gave a short notice of this lamp in our issue of May 24th last; it is, we believe, the first successful attempt to apply the principle of the inductance coil to the regulation of individual direct-current arc lamps, although a somewhat similar method was promulgated for dealing with them when run in series from high pressure circuits, the idea then being to enable two series of lamps, each taking about 5 amperes, to be run in parallel off a circuit in which the bulk of the lamps were 10 amperes single series.

The choking coil is connected in series with the lower (coarse) winding of the regulating solenoid, and thence, by means of a flexible cable, to the upper carbon, with which it has always a positive connection, which is vastly superior to the usual method of sliding contacts.

A shunt is also taken around the choking coil, which passes through the upper fine winding of the regulating solenoid.

The action of the lamp is as follows:—As long as the current through the arc is steady, there is, of course, no inductive effect in the choking coil, which simply acts as a resistance, but fully chokes off any change of current in that direction whilst not preventing changes of current in the circuit shunted around it, the regulating solenoid thus anticipating, to a certain extent, the changes of current in the arc and preventing them from becoming excessive. No adjustment is, as a rule, required, the arc voltage increasing with that of the line; but on circuits subject to great and sudden variations of pressure, it may be advisable to reduce the arc voltage, for which purpose a small adjustable resistance in series with it is provided. Another small resistance in series with the shunt on the choking coil enables the amperes taken by the lamp to be changed, by varying the current in the upper coils of the regulating solenoid.

The net result of the adoption of this principle of regulation is that a considerable amount of resistance in series with the arc is done away with, so that whereas in the old lamps not more than about 75 per cent. of the power could be utilised in the arc, 88 per cent. is available for the production of light in the "Continental" when running on 100 volts. As no more resistance is introduced on higher pressures, this percentage is increased as the voltage of the circuit approaches 120, the highest for which the lamp is at present made, and at which the watts available for the production of light are in excess of 89 per cent.

Owing, perhaps, to the steadier current, not to speak of the wider separation of the carbons, it is further found by test that, watt for watt, 11 per cent. more light is produced. The total efficiency of the combination as a light producer is, therefore, very high, it being claimed that 30 per cent. more light is obtained for the same expenditure of energy.

Not the least of the improvements introduced into the lamp is the new form of inner bulb, which is completely closed at the lower end, and quite independent of the lower carbon holder. The alignment of the two carbons does not, therefore, depend on the way in which the trimmer puts on the bulb. Further, the movable bulb cover being done away with, it is impossible for the upper carbon to jam in the hole through it, as constantly occurred when the parallelism of the cover depended on the fact that the upper edge of the bulb was exactly at right angles to the carbons.

The lamp being trimmed as easily as an "open" arc, utilising a greater percentage of energy than has hitherto been possible on any lamp, open or enclosed, when run on low pressure circuits, having an inner bulb completely closed, and therefore free from possibility of leakage at the bottom, and being of simple construction and good make, we see no reason to modify the good impression we expressed in our first notice of this lamp.

A Conduit Wiring Development.

Mr. Fred. Bathurst, who is well known in the electrical trade as the "conduit expert," has taken offices at 1, Oxford Court, Cannon Street, E.C. He has his improved conduit system well in hand, but hardly expects to have a complete stock of the detail parts before the Christmas holidays, and therefore proposes to get every thing quite straight to start fair into business with the new year.

Telescopic Scaffold.

Mr. J. H. Heathman, of Parson's Green, well known as a maker of ladders and tower wagons for electric lighting engineers, notifies that he has now produced a telescopic folding scaffold capable of being easily transported and stowed in small compass, and of quick and safe erection by unskilled labour. This is thought to be a great convenience for electric wiring contractors.

Royce's Arc Lamps.

In their newly-issued catalogue of arc lamps and accessories, Messrs. Royce, Limited, of Hulme, Manchester, refer to their chief specialities. There are brief general specifications of the "Royce" vertical arc lamps of the continuous and alternating current types, also their inverted lamps. Their enclosed arcs for both alternating and continuous, and for parallel or series working, are also included. Among other interesting things which we observe is the firm's arc lamp elevating gear. In this device the cables to the lamp terminate in it, so permitting the lamp to be lowered any distance by a cord without the cables festooning down to it. A small contact piece of cylindrical form is fixed above the lamp, and to it the rope is attached, so that on the lamp being raised the contact piece to which the two terminals of the lamp are connected is drawn into the ceiling fitting, and the circuit through the lamp is formed. The lamp, when fully raised, can be suspended any distance from the ceiling by a tube of any desired length intervening between the lamp and the contact piece. The elevators are fitted with a projecting weatherhood, when required, for outside use. They are only supplied under Messrs. Royce's warranty. Arc-lamp brackets, and pole fittings for fixing arc lamps to wooden poles, are also well shown in this catalogue, of which the trade should secure copies.

Trade Catalogues.

We have received the latest price list of arc lamps and accessories issued by Messrs. Smithson, Sharpe & Co., of Chase Street, Red Bank, Manchester. This gives illustrations and descriptions of lamps for direct and alternating circuits, upright and inverted. It is claimed for these that they contain the minimum of mechanism, which is also dust and waterproof, combined with the maximum of strength. Automatic magnetic cut-outs for series lamps, and an arc lamp elevator, resistances, transformers chokers, &c., are also listed.

A copy of the new catalogue of "Prometheus" electric heating and cooking apparatus has just been issued by Messrs. Berend and Co., Limited, of Dunedin House, Basinghall Avenue, E.C. The special feature of this system is the use of heating strips formed by depositing precious metals on thin mica sheets, instead of embedded resistance wires. The large surface of these strips enables equal results to be obtained without raising any part to a high temperature, thus ensuring reliability and long life. The temperature, in fact, is limited to about 400° C., corresponding with about 75 watts per strip 6 in. by 1¼ in. Otherwise the metallic film can be deposited in broad bands on insulating enamel on the apparatus itself, which are protected from injury by an outer casing. Cooking utensils, hot-water jugs, milk sterilsers, foot warmers, radiators, irons, &c., are illustrated and described, with prices attached.

We understand that Messrs. Isenthal & Co., whose electric heating apparatus is described in another column, have in the press a new list of embedded rheostats and measuring (moving coil) instruments.

Messrs. Benham & Froud, Limited, of Chandos Metal Works, W.C., have a new catalogue of special electric light fittings in the printer's hands. It will be issued to the trade very shortly.

From Gebr. Senftleben and Zschocke, of 26, Waldemar Strasse, No. 53, Berlin, we have received a catalogue of electro-medical batteries and instruments. The first half of the list is devoted to a tabulated arrangement of reference numbers, titular description, and prices, the last half being given up exclusively to illustrations.

The Crypto Works Company, Limited, of 29, Clerkenwell Road, E.C., have brought out a new catalogue of their specialities. There are several new types introduced, which have not appeared in previous lists. A 300-watt dynamo or ⅓-H.P. motor, shown in the list, we understand to be in considerable demand. The Crypto new pattern alternator for medical baths, foot and hand driving gear, motor-driven fans, and a number of small details, are shown and priced.

Messrs. Geck Bros., engineers and patentees, of Altena, Westphalia, have sent us a list of their patent continuous wire-drawing machines, of which over a thousand are in use in different parts of the world. The machine is suitable for drawing steel, mild steel, iron, copper, brass, German silver, aluminium, bronze wires, &c., and is built in three different sizes. The general agent for Great Britain and the Colonies is Mr. Ed. Brand, of Broad Street House, E.C.

The Langdon-Davies Electric Motor Company, Limited, of 101, Southwark Street, S.E., have fresh from the press a new issue of their single-phase alternate current motor catalogue, which contains a good amount of new information. It should be mentioned that the company have recently made considerable reductions in the prices of their larger sizes of motors of this class. The list is very neatly got up with art paper, and many illustrations giving photographic views of the works and the applications of the motors for machine driving.

A new catalogue of the "P.T.L." heating specialities has been brought out by the British Power, Traction, and Lighting Company, Limited, of York. The following are a few of the things which appear in this finely illustrated list:—Paul's concentric liner tubes, exhaust steam feed water heaters, triple-tube waste steam economisers, triple-effect feed water heaters, live steam calorifiers, regulators, air heaters.

The Ferracute Machine Company, of Bridgton, New Jersey, U.S.A., send us a copy of their catalogue, No. 14, of presses and dies.

Electric Tramways in Surrey.

The issue of the *Spectator* for October 19th contains an article upon the subject of electric tramways in Surrey. The writer of this article is concerned lest the Light Railway Commissioners should grant powers to the private companies promoting these extensions into Surrey without extorting an adequate *quid pro quo*. The article is interesting as indicating the attitude of the impartial outsider towards all tramway schemes involving the use of the public roads, and it may be read with advantage by all engaged, either financially or otherwise, in the work of providing London with better transit facilities. The recommendations of the writer of the *Spectator* article are summarised in the concluding paragraph as follows:—"To sum up, then, we would by no means adopt a hostile attitude towards tramway extensions in rural districts, but we would make it a fixed administrative principle that no highway authority should grant the right of laying tramlines to any company unless that company agreed to increase the metalled surface of the road by the width of the cars to be employed. Our roads must be widened if they are to bear the extra traffic that is coming to them, and it is only fair that the companies which design to make a profit of the roads should be made to pay a reasonable contribution for the privileges they ask."

The policy outlined in the above paragraph has already been adopted in several instances, and electric tramway companies have been granted the requisite running powers, only on condition that they carry out certain street improvements in the districts which they proposed to serve. There is no doubt that this policy has the support of the outside public, and it is not unlikely, therefore, that it may in time become, as the writer of the *Spectator* article desires, "a fixed administrative principle" when granting tramway concessions to private companies. Nevertheless, we think it will be a mistake if the expenditure for widening all country roads be thrust upon the new electric tramway companies rather than upon the rural highway authorities. Electric tramways and light railways owe their popularity and success chiefly to the fact that they offer cheaper transit facilities than those already in existence. To adopt as "a fixed administrative principle" a policy which will add very largely to the capital outlay on such schemes, will be unwise, for it will permanently increase the cost of this mode of travel, and will thus tend to check that migration from the crowded centres of industry to the country districts, which is one of the social necessities of our day.

The writer of the *Spectator* article has wholly ignored the important argument against the policy he approves. It would be interesting to have his opinion as to the means by which low fares are to be reconciled to an inflated capital expenditure. The preliminary expenses for obtaining the sanction of local and other bodies to tramway schemes are already very heavy. If to these are added still greater outlays for road improvements, one of the chief advantages of electric traction—namely, its economy—will be in a fair way to disappear.

A New Optical Electric Phenomenon.

A very interesting phenomenon, illustrative of the close connection between light and electricity, and consisting of an optically sensitive electrode, has recently been discovered by Dr. Emil Bose, of Breslau University. If an electric current be passed through a slightly acid solution for a long time with gold electrodes, the electrode by which the current passes into the solution (the anode) alters considerably in appearance, becoming coated with a covering of gold hydroxide. If now the charging current be stopped and the electrodes connected to a high resistance galvanometer, it is found that the E.M.F. of the combination depends on the illumination of the oxidised gold electrode. The differences in E.M.F. obtained amounted in some cases to as much as 0·1 volt, very strong lights such as the arc, magnesium light, Welsbach light, &c., causing the potential of the electrode to drop. The different action of the various parts of the spectrum are interesting. Pure violet light, obtained, for example, by means of a prism from an arc lamp, has the same effect as white light, *i.e.*, lowers the potential. Sodium light and the yellow and green parts of the spectrum have hardly any effect. Red light (*e.g.*, the lithium flame, or the arc light seen through a red glass) raises the potential, even to an amount greater than the high value reached in the dark. The invisible impaired rays act similarly. Röntgen rays have also a very strong action similar to white light. The different action of the red and the violet rays is one of the very rare cases in which the different parts of the spectrum act qualitatively differently. In nearly all other optical phenomena the effects of the red and violet rays are qualitatively alike only different quantitatively. It is possible that practical good may result from these observations. If the effect is proportional to the cause, *i.e.*, to the illumination, which seems probable, the phenomenon may form the basis for the construction of a direct reading photometer, that apparatus so earnestly desired by all who have to do with photometric measurements.

ELECTRIC SUPPLY PROGRESS IN GERMANY.

The annual statistics of German electricity works, compiled by the *Elektrotechnische Zeitschrift*, are abstracted in the columns of our New York namesake. It appears therefrom that at April 1st, 1901, there were 768 electricity supply works in operation, as compared with 652 in the preceding year. 318, or 40 per cent., of the works sent in the total of their capital expenditures, and an average of these shows that the expenditure has been at the rate of 1,628 marks (about $407) per kilowatt of generating plant installed. A further estimate shows that the total capital expenditure of public electricity supply works, exclusive of tramways, in Germany, must be about 540,000,000 marks. Eighty-one and three-tenths per cent. of the works generate nothing but continuous current, as compared with 80·4 per cent. last year. However, this only represents 43·8 per cent. of the total kilowatt capacity of all the works, a decrease of 3·6 per cent. since last year. This is explained by the fact that there is a large number of small works with outputs below 100 kw. supplying continuous current, while the larger works usually lie at a distance from the supply areas, and generate three-phase or single-phase current, which is led to sub-stations. The number of three-phase + continuous-current systems has increased from 38 to 43 (41,757 kw. to 86,985 kw.), and the number of combined single-phase + direct-current systems from 6 to 10 (1,599 kw. to 6,874 kw.). The number of purely three-phase works has increased from 39 to 45 (35,150 kw. to 40,759 kw.), and of works employing nothing but single or two-phase from 42 to 44 (21,572 kw. to 27,547 kw.). In two works, with an aggregate capacity of 950 kw., monocyclic generators are employed. Most of the continuous current stations are equipped with batteries, only 24, or 33·8 per cent. of the whole, being without them. An interesting figure is obtained from the total capacity of the accumulators, from which it is calculated that, on the average, their capacity is

36·2 per cent. of the capacity of the generators in the works in which they have been erected. Of the total 768 works, 56·4 per cent. have a smaller capacity than 100 KW., and there are in all 38 works with capacities of over 2,000 KW. The largest of these is the huge water-power station at Rheinfelden, the capacity of whose generators is 12,000 KW.; and next in order comes the Oberspree station, near Berlin, with a capacity of 10,770 KW., both these figures being exclusive of sub-station equipment. The connections to the mains of all the 768 stations represent an aggregate of about 352,500 KW., an increase of 28·8 per cent. over last year. No less than 38·6 per cent. of the total kilowatts connected is represented by motors. Ninety additional works are being constructed or definitely projected.

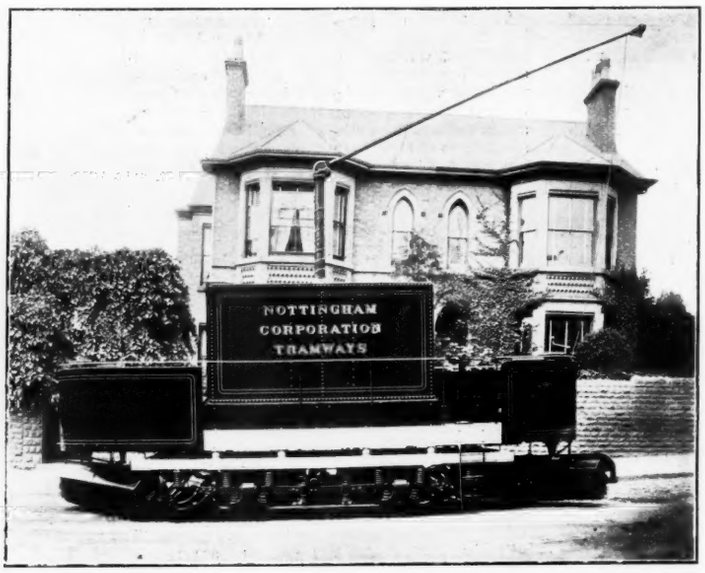


FIG. 1.—TRACK SWEEPER AND WATERING CAR.

AN ELECTRIC TRACK SWEEPER AND WATERING CAR.

THE introduction of electric working on tramways is calling into existence various auxiliary apparatus which is of very considerable importance in the efficient operation of a tramway system. One need hardly point out that there are distinct advantages in keeping the track and the rails clean, and in this connection the advantages of a track sweeper car and a watering car are now being recognised by tramway managers, a number of lines in this country being already equipped with them. It is sometimes desirable to employ a car which can be utilised both for watering and sweeping, and there are no special difficulties in designing such a car.

From a sanitary point of view, the development of an electrical watering car is of considerable importance, because it would be easy to combine with it special watering apparatus by which the entire roadway could be cleansed very much more efficiently and quickly than by the antiquated water barrel.

In America, a good deal of street sweeping and watering is carried out by specially designed electrical cars; and with the extension of tramways in this country, it is obvious that the advantages of this system will become generally accepted.

We reproduce two interesting examples of track sweepers and watering cars, which have been supplied by Messrs. Dick, Kerr and Co., Limited, to the Corporations of Nottingham and Bolton.

Fig. 1 illustrates a combined track sweeper and watering car, built to the design of Mr. Arthur Brown, borough engineer of Nottingham, and consists of a tank and accessories, mounted on an ordinary car truck. The floor framing is built of well seasoned pitch-pine and oak, the side sills being extended the whole length of the frame to provide a platform at each end. There are fixed at each end of the car series parallel controllers, the equipments as regards motors and trolleys being of the same standard pattern as obtains on ordinary cars. Each car carries two revolving brushes, which are placed at each end, and are arranged to revolve in either direction. Gear is provided on each platform, by which the brushes can be lifted off the track. The brushes are driven by a chain wheel attached to the axle of the driving wheel. Only one brush is in operation at one time, a clutch being provided by which either of the brushes may be put out of action. In order to give sufficient and convenient access to both the brush-driving gear and the bearings, trap doors are provided on the platform. At the end of each platform are dashes composed of steel sheet supported by wrought-iron rails and standards. The water tank is composed of ¼ in. iron plates, and has a total capacity of 500 gallons. For cleansing the groove in the rails a small pipe of ½ in. bore is placed on either side of the tank, and the water-jet, playing directly over the rail, effectually removes any accumulation of dirt. Valves for controlling the water pipes are provided on each platform.

The track sweeper is mounted upon a Brill 21 E. truck; the motors and controllers are similar to those provided on the Nottingham cars, and are manufactured by the English Electric Manufacturing Company, Preston.

Fig. 2 illustrates the type of watering car supplied to the Bolton Corporation Tramways, the tank in this case being considerably larger, and capable of holding 1,500 gallons. It also differs from the former car, in that a canopy roof is arranged to cover the whole of the floor frame, which, in addition to providing some protection against inclement weather, forms a suitable foundation for the attachment of the trolley base. This type is also provided with a small water pipe and brushes for cleaning the grooves.

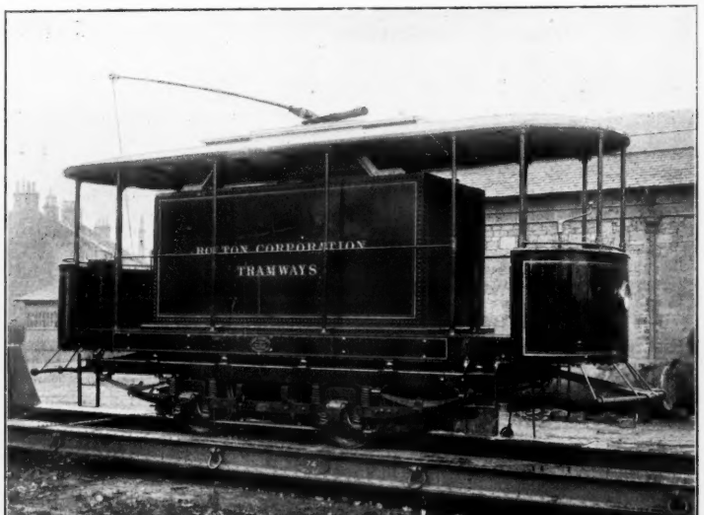


FIG. 2.—WATERING CAR.

Electrical Trade in Greece.—The U.S. Consul, Mr. McGinley, at Athens, reports that the Mayor of Karpenesion, a village in the province of Evrytania, wishes to have that place lighted by electricity, and has requested the Consulate to publish the fact in the United States, hoping to induce some American company to sell him a suitable plant. There is a stream near the village that can be utilised to furnish the necessary power for the plant. There are 400 houses in the village, and the Mayor estimates that about that number of incandescent lights will be required. A New York exchange remarks that this is but one of several electrical opportunities recently suggested from Greece.

The Philippine Islands.—The import duty, under the new Customs tariff, on storage batteries for lighting and power purposes imported into the Philippine Islands is fixed at $25 per 100 kilogrammes.

ELECTRIC TRACTION NOTES.

(*Continued from page 752.*)

Nottingham.—An undertaking is being promoted to construct a light railway to be worked by electricity from Nottingham to Stapleford, a distance of about 10 miles. Some time ago the local authorities at Stapleford petitioned the Nottingham City Council to extend the city electric tramways to that and neighbouring townships and villages. At a meeting of the Stapleford Rural District Council on Monday the new scheme was discussed.

Perth (W.A.).—The construction of the Kalgoorlie electric tramway is being rapidly pushed forward (says the *Financier*). Nearly all the poles have been erected and the rails and overhead material have arrived at Fremantle. The work is being carried out under the supervision of Mr. Somerset, the engineer to the Perth Electric Tramways, and formerly chief electrical engineer to the Canadian Pacific Railway. The assistant engineer is Mr. Childs, who built the first section of the Perth electric tramway. All the previous hostility to the tramway in Kalgoorlie has disappeared, and been replaced by keen anticipation and appreciation, though the Boulder municipality refuse to co-operate, and insist upon abiding by the decision to run a separate tramway and erect a separate power house.

Rochford.—At the last meeting of the D.C., the town clerk of Southend, Mr. W. Snow, wrote that the Town Council contemplated applying for an order authorising the construction of certain additional light railways, which would include routes to Rochford, Great Wakering, Hadleigh and Rayleigh. Several members of the Council thought they should oppose the scheme because it would deprive them of the full use of the roads. It was agreed to appoint a committeee to consider the question.

Royton.—The D.C. has authorised the Tramway and Electricity Committee (jointly with the Crompton D C.) to report upon the advantage or otherwise of having a joint electricity station, to appoint deputations to visit works, to report as to suitability of engineers to carry out the works in contemplation, and of the various kinds of electrical and tramway schemes in operation or in progress; also to solicit competitive applications from engineers, if thought desirable, and to ascertain the terms upon which the various private electrical or tramway companies are prepared to take over the transferable powers of the Council or to supply electrical energy.

Swansea.—A conference was held here last week of representatives of the Swansea and the Glamorgan County Councils to consider the question of the control of the proposed new Swansea tramways beyond the borough boundaries. The County Council has three schemes in hand. These are to carry the tramway service from Swansea to Longhor, another from Maniston to Ystalyfera, and the third from Maniston to Neath. Under the recent Light Railway Order, the Swansea Council have power to extend the present town electric service to Maniston, to Sketly, and to Cockett. The Glamorgan Council wishes the Swansea Council to surrender the rights beyond the borough boundary. There is a tacit agreement between the parties, but the conference was adjourned without anything definite being decided.

Taunton.—Just 11 weeks ago the British Electric Traction Company started its electric tramline running from the Great Western Railway Station to the eastern (and opposite) end of the borough. At the end of 10 weeks' running the number of passengers carried had been 214,553, or 3,400 per day, making a weekly average of a number equal to the total population of the town. The directors of the owning company, the Taunton and West Somerset Electric Railways and Tramways Company, Limited, who are identical with those of the Electric Traction Company, gave a banquet on Wednesday, October 30th, at the Castle Hotel, Taunton, to celebrate the successful inauguration of the system, some leading electricians and the members of the local Corporation being invited. Mr. J. S. Raworth, M.Inst.C.E., technical director of the company, presided, and complimentary speeches occupied the evening after dinner had been discussed.

Tipton.—The Council last week resolved to promote a Bill to confer powers upon the Council to acquire the tramways and to electrically equip them.

Torquay.—The T.C. has received from the Provincial Electrical Supply Company formal notice of their intention to apply for a provisional order to run electric trams in Torquay. At a meeting of the Paignton D.C. on Monday a letter was read from the Power and Traction Company, Limited, stating that they proposed to carry out a comprehensive scheme of tramways for Torquay, Paignton and district. The company propose the overhead trolley system for the trams, as did also the first-named company, with this exception—that in the narrowest portions of the Torquay streets the open conduit system would be used. The Provincial Company also proposed to run a track by the side of the roads, and to keep the roads in repair a foot on either side of the track. The meeting approved of the principle of the schemes.

Willenhall.—The B.E.T. Company has informed the U.D.C. that the work of reconstructing and electrically equipping the tramways authorised in the district will be commenced in a few days. It was added that the tracks will be ready for running from the month of May next.

TELEGRAPH AND TELEPHONE NOTES.

Cape—Australia Cable.—The *Morning Post* says that on the occasion of the opening of the Cape—Australia cable the following telegram was received by the Eastern Extension Telegraph Company from Lord Tennyson, Governor of South Australia:—

"Twenty-nine years ago telegraphic communication between Adelaide and London was first established, greatly owing to the courage of Sir Charles Todd and his associates, who joined Port Darwin and Adelaide by overland wire through Central Australia, and to-day we heartily congratulate the Eastern Extension Company for joining Adelaide and South Australia with London by an alternative cable by way of South Africa. That would be most important, but it is also a connecting link between several strategic outposts of our Empire and the Mother Country, every part of which can be under the protection of British ships. Our entire community are grateful to you for this and for your reduced charge of cables, and for the greater facilities thus given to commercial enterprise.

East Lancashire Telephones.—Darwen has asked Blackburn Mayor to convene a meeting of representatives of East Lancashire boroughs to discuss the advisability of establishing a municipal telephone service for Darwen, Blackburn, Accrington, Clitheroe, Whalley, Rishton, Great Harwood, and other places.

Manchester Telephones.—The City Council will hold a special meeting on November 13th "to take into consideration and determine upon the expediency of joining with other local authorities in the Manchester telephone exchange area in the promotion of a Bill to constitute a board consisting of representatives of corporations and district councils within the said area, or some of them, for the purpose of providing a system of public telephonic communication within the area; for enabling the Postmaster-General to grant to the board, and the board to accept, licenses for telephonic purposes under the Telegraph Acts, 1863 to 1897, and the Telegraph Act, 1899; and to confer and impose upon the board and the several constituent authorities all necessary and proper powers and obligations in that behalf; and also (if deemed expedient to promote such Bill) for charging all or some of the expense of promoting such Bill upon the city fund and city rate, or on such other fund or rate as the Council shall deem advisable."

Milan—Turin—Paris Telephone.—The new trunk line between Milan, Turin and Paris *vid* Mont Cenis, will be open to international communication at the end of the present month. This line will immediately afterwards be followed by the inauguration of another line from Milan to Zurich, of which there remains but the Como—Chiasso section to complete. By means of the Paris—Milan line, the latter town will be placed in communication with London, and by means of the Milan—Zurich line, London will be in communication with Berlin. The construction of a direct line between Milan and the German capital is at present under discussion.

Portsmouth Telephones.—The license of the Postmaster-General has been obtained by the T.C., and this week a Local Government Board inquiry *re* loan has been held.

Telegraph Rates.—An alteration of rates on telegrams to Aden and several places on the Eastern seaboard of Africa came into force on November 1st. With the exception of Madagascar and Zambesia, which are fixed at 4s. per word, the rates for all other places range from 3s. to 3s. 6d. per word. Telegraphic communication has been established with Klondike, and the rates to Alaska, British Columbia, and the North-West Territory of Canada have been revised.

Telegraph Steamer "Viking."—The *Viking*, says the *Newcastle Daily Leader*, was launched from Messrs. Sir W. G. Armstrong, Whitworth & Co.'s shipyard at Walker, last week. She has been built to the order of the Amazon Telegraph Company, and is required for work on the river of that name, where she will be employed in picking up the telegraph cable which lies along the bed, repairing it, and laying new lengths when it is desired. The speed of the current which she has to withstand renders large propelling power necessary, and as the draught of water is very limited the form of the ship and the type of the propelling machinery require careful consideration. The vessel in question is single-decked, 218 ft. long and 36 ft. beam, and the draught of water when fully loaded is only 10 ft. As the climate in which the vessel will have to work is exceedingly treacherous, and the efficiency of the ship depends largely upon the health of the crew, special attention has been paid to the ventilation throughout the ship, and all the living rooms are so arranged that an adequate supply of air is at all times available, while at the same time the shade deck has specially arranged awnings to afford shelter against the tropical rains which are of frequent occurrence. There are three cable tanks fitted up in accordance with the latest practice. A powerful "picking-up" and "paying-out" machine is fitted on deck, and is capable of picking up cable under a strain of 20 tons. The propelling machinery is of the twin screw triple-expansion type, and has been built by the Wallsend Slipway and Engineering Company.

West Riding Telephone Conference.—The Leeds, Bradford, Sheffield, and Halifax Corporations were represented at a conference on municipal telephones held at Leeds last week. It was determined to recommend the West Riding municipalities to simultaneously apply for licenses, that a joint committee should be formed to carry the resolution into effect, and that there should be no terminal changes between the authorities entering into the scheme. Huddersfield was not represented at the conference, but is already in possession of the necessary authority, and intends shortly to apply for borrowing powers.

Wireless Telegraphy.—The Brussels correspondent of the *Daily Chronicle* reports that a resident of Samarang, Java, has applied to the Dutch Government for the definite concession of the application of wireless telegraphy in the Dutch East Indies, with a view to connecting Java with the adjacent coasts. It is also proposed to instal the instruments in the various postal telegraph offices and railway stations of the island, and to provide the different light-houses round the coast with receivers with a view to taking messages from steamers at sea.

At Frinton-on-Sea, Essex, there has just been established a station for instruction in Marconi's system of wireless telegraphy. The station is under the superintendence of Mr. T. Bowden, and messages have been exchanged with the South Foreland, a distance of 50 miles. "At present there are six resident students, but it is expected that under the recent agreement with Lloyd's a large number of pupils will pass through the school."

The *Morning Post* Rome correspondent states that the Italian naval officers, after many experiments, have succeeded in establishing communication between Spezia and Sardinia, a distance of more than 200 kilometres, with the Marconi apparatus.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—November 26th. Overhead line work, cables, bonding, &c., for Corporation tramways. See "Official Notices" to-day.

Amsterdam. — November 18th. Electrical overhead construction, rail bonds, &c, for the City Council. See "Official Notices" October 18th.

Army Contracts.—The Secretary of State for War gives notice that tenders for specific quantities of the undermentioned articles will probably be invited from time to time during the next 12 months, namely:—Acids, Electrical Instruments, Telegraph Cable. See "Official Notices" October 18th.

Barking Town. — November 12th. An electrically-driven loco. crane, and permanent way for the U.D.C. See "Official Notices" October 18th.

Boulder City.—November 23rd. The Council invites tenders from manufacturers for the construction of a tramway system, plans and specifications of which are to be seen at the office of the Agent-General, London. See "Official Notices" September 20th.

Brighton.—November 25th. Meters for one year for the Council. See "Official Notices" to-day.

Bury.—November 18th. 28 electric tramcars for the Tramways Committee. Lacey, Clirehugh & Sillar, engineers.

Coventry.—November 27th. Triple-expansion low speed engine, 400-KW. alternator and exciter for the electricity works. See "Official Notices" to-day.

Croydon.—November 18th. Balancer sets and switchboard for the Corporation electricity works. See "Official Notices" to-day.

Dublin.—November 25th. The D.U. Tramways Co. wants tenders for stores, including car fittings, electrical supplies, &c. See "Official Notices" November 1st.

Dundee.—November 11th. Eight tramcars for the T.C. See "Official Notices" November 1st.

East London (S.A.).—November 26th. Tenders to Mr. R. N. Moir, Town Clerk, for 50-KW. alternator and engine. London agents, Messrs. Dyer & Dyer, Aldermanbury, E.C.

Farnworth. — November 11th. The Electricity Committee invites tenders for wiring and fitting up the tramway depôt for lighting and power. Mr. J. D. Pember is the electrical engineeer, Albert Road, from whom specifications, &c., may be obtained (10s. 6d. returnable as usual). See "Official Notices" to-day.

G.E. Railway.—November 22nd. The directors want tenders for stores as per details given in our "Official Notices" to-day.

Hull.—November 28th. Six rotary transformers for continuous current transformation, 2,000 volts to 200 volts, 90 KW. each. See "Official Notices" November 1st.

Islington.—November 26th. Arc lamps, columns, and cables for the Council. See "Official Notices" November 1st.

Lancaster.—November 27th. Rails, fishplates, bonds, bonding, overhead equipment, feeder cables, pilot wires, tramcars, &c., for the Corporation tramways. See "Official Notices" to-day.

Leigh.—November 16th. Triple concentric cables; 12 months' supply for the Co poration. See "Official Notices" to-day.

Manchester.—November 9th. Telescopic and rigid tower wagons for the Tramways Committee. See "Official Notices" October 25th.

Manchester.—Two 6,000-H.P. triple-expansion engines, two 3,750-KW., three-phase alternators, 48 motor-generators for Stuart Street generating station, and sub-stations. See "Official Notices" October 11th.

Mansfield.—November 11th. The T.C. is now inviting tenders for the buildings of electricity and dust destructor works.

Newport (Mon.).—November 11th. Monmouthshire County Council is inviting tenders for the electric lighting of the new council chamber and offices at Newport. Specifications, &c., of Mr. W. Tanner, Newport.

Rochdale.—November 8th. Boilers, economisers, stokers, condensers, &c., for the electricity works. See "Official Notices" October 18th.

Rome.—November 16th. At a Ministry of Public Works, Rome, on November 16th tenders will be opened for the supply and installation of necessary apparatus, &c., for the distribution of electric energy in the Hospital Humbert I, at Rome. A delay of six months will be allowed for the execution of the works. Full particulars can be had on application to the Secretary.

Rotherham.—November 12th. Wiring the Hospital for electric lighting. Specifications from the borough electrical engineer, Mr. E. Cross, Rawmarsh Road, Rotherham.

Spain.—November 15th. Tenders are being invited until November 15th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system in the town of Valdepeñas (province of Ciudad Real). Particulars can be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Madrid.

South Lancashire.—November 25th. Overhead electrical equipment of lines for the S. L. E. T. and Power Company. See "Official Notices" October 25th.

St. Annes-on-the-Sea.—November 15th. Street mains for the U.D.C. See "Official Notices" November 1st.

Stoke Newington.—November 18th. Electric lighting cables. See "Official Notices" to-day.

Swindon.—November 12th. Boilers, cooling tower, 10-ton crane and other plant for electricity works. See "Official Notices" October 11th.

Willesden.—November 12th. Boilers, steam dynamos, transformers, motor-generators, switch-gear, cranes, battery, mains, public lamps, piping, condensing plant, &c., for the D.C. electricity works scheme. See "Official Notices" October 25th.

Wimbledon.—November 14th. Tenders for wiring the electricity works. See "Official Notices" November 1st.

Woolwich.—November 15th. Electrical instruments for the Council. See "Official Notices" November 1st.

CLOSED.

Batley.—The T.C. has accepted the tender of A. Graham and Sons, of Huddersfield, for permanent way work for the electric tramways.

Bradford.—The Corporation has accepted the offer of Demerbe & Co. to supply and lay on the Demerbe system, on the same terms and conditions as last contract, the tramway track required in the construction of an extension line along Horton Park Avenue and Little Horton Lane. The tender of Messrs. W. H. Allen & Son, Limited, for two centrifugal engines and pumps at Valley Road electricity works for £1,670 has also been accepted.

Bristol.—The Electrical Committee has accepted the tender of Messrs. Jones & Horsfield for laying pipes at the Avonbank works.

Glasgow.—It is stated that the National Conduit Cable Company has secured a further £50,000 contract from the Corporation for wires and other materials necessary for the extension of the electric tramways. Low price and quick delivery are said to have secured the contract to this company.

London.—The London County Council on Tuesday decided the following contracts in connection with the reconstruction of the tramways between Westminster Bridge and Tooting, &c.

(A).—Track Rails and Fastenings.

British Westinghouse Electric and Manufacturing Company ..	£33,534
Barrow Hæmatite Steel Company	29,341
Walter Scott, Limited (The Leeds Steel Works) (accepted) ..	25,443
Bolckow, Vaughan & Co.	23,876

(B).—Slot Rails, Conductor Tees and Fastenings.

British Westinghouse Electric and Manufacturing Company ..	£29,954
Walter Scott, Limited (The Leeds Steel Works) (accepted) ..	25,334

The Highways Committee, in referring to these tenders, stated:—

As regarded the specification (A), Messrs. Askham Bros. tendered

for bolts and nuts only at £640; while as regarded the specification (B), the Barrow Hæmatite Steel Company tendered for slot rails and fishplates only at £15,065, and gave no price for the conductor rails, bolts, or any other part of the work. The tender of Messrs. Walter Scott, Limited, for the slot rails and fishplates is £14,650, and Messrs. Askham Bros. tender for the bars and nuts only at £2,498. Messrs. J. G. White & Co. tender for the bars and connections, which will be required if their alternative tender for roadwork be accepted, at £5,150.

It will be seen from the list that the lowest tender for (A) the track rails is that of Messrs. Bolckow, Vaughan & Co., and the next lowest that of Messrs. Walter Scott, Limited. The first-named firm does not, however, tender on the specification (B) for slot rails; and Messrs. Walter Scott's tender is not only the lowest for that specification, but they accompany their tender for (A) by a statement that they cannot undertake (B) unless (A) also is entrusted to them. In the circumstances Dr. Kennedy considers, and we agree with him, that it is advisable that, subject to the result of the usual inquiries proving satisfactory, the tenders of Messrs. Walter Scott should be accepted for both (A) and (B).

Messrs. Scott state that they can deliver the first 500 tons of track rails within 12 weeks from the date of order, and that they will afterwards deliver from 100 to 150 tons per week, which, in the opinion of Dr. Kennedy, will be as much as the roadwork contractors will be able to deal with as the work progresses. As regards the specification (A), Messrs. Scott propose as their sub-contractors for bolts and nuts the Helicoid Lock-Nut Company, of Acton; and also to employ the Coghlan Steel Company, of Hunslet, to roll the fishplates and other small work, for which Messrs. Scott will themselves manufacture the metal. Under specification (B) they propose the same sub-contractors for bolts and nuts as under (A), with the addition of another sub-contractor for the tie-bars.

(C.)—Execution of Road Work and Platelaying.

British Westinghouse Company	£230,932
British Insulated Wire Company	194,168
Dick, Kerr & Co.	189,013
E. Nuttall	185,870
" (alternative)..	183,870
W. Griffiths & Co.	183,631
J. G. White & Co., several tenders ranging from	183,131
" " to	165,384
J. G. White (accepted)	171,145

The observations of the Highways Committee on these tenders were as follows:—

The tenders of Messrs. J. G. White & Co. are the lowest throughout, and consist of different combinations of three sections of the work, namely—(*a*) roadwork; (*b*) hydrants and water supply; and (*c*) special work; and, according as these three sections are combined in different ways, the tenders vary in amount from £183,131 to £165,384. The lowest combinations are those in which the special work is proposed to be manufactured by Messrs. Askham Brothers, of Sheffield. On investigation, however, it has been found that Messrs. Askham's works, though well equipped for turning out excellent material, are not so arranged as to conveniently produce the really heavy castings which will be required, and Messrs. White & Co. have in the circumstances withdrawn these tenders. For the roadwork proper, exactly to specification, Messrs. White & Co.'s tender is £140,849, and, to an alternative specification of their own, is £146,847. This alternative allows for yokes spaced 3 ft. 9 in. apart instead of 5 ft., and for other modifications; and if the alternative were accepted certain other items would have to be added, making a total for the alternative of £149,313. Dr. Kennedy has endeavoured to combine the best features of his specified scheme and of the alternative proposed by Messrs. White and Co.; and, having gone through these in detail, he finds that the corresponding price for the roadwork section would be £145,850. As regards the special work, namely, points and crossings, Messrs. White & Co. originally tendered both for the Lorain Company's work and that of Messrs. Askham Brothers, but the latter has, as above stated, been withdrawn. Messrs. White included two tenders for Lorain work, the one at £24,161 and the other at £30,873, the latter being for what is known as "guarantee work" throughout, a number of the parts being so made as to be renewable. Dr. Kennedy does not think it desirable that the higher price should be accepted, but that Lorain "guarantee work" should be selected for crossings where the wear will be greatest; and this would add £1,134 to the lower offer, making the amount £25,295. Of the different tenders sent in by Messrs. White & Co, Dr. Kennedy suggests, and we agree with him, the acceptance of the combination under which the roadwork would cost £145,850 and the special work £25,295, making a total of £171,145. The modifications proposed will affect, to a small extent (perhaps an addition of £250) Messrs. Scott's contract price under (B); but this is a very small matter, which can be adjusted hereafter.

We are informed by Dr. Kennedy that the firm of Messrs. White and Co. is the English branch of a very well-known American firm under the same name which has, in America, done a great deal of work of an important character, and that Messrs. White & Co. possess as their chief engineer a gentleman who has carried out a great deal of electrical conduit system work in the United States and on the Continent of Europe, including the conduit work in Paris. They undertake to commence the work in the roads within 13 weeks after receiving notice to do so, and to complete it within 13 weeks from commencement, provided that they will be allowed to work in six lengths of 440 yards each at the same time. We anticipate that no difficulty will be raised by the road authorities concerned who will naturally be as anxious as the Council that the work shall be completed within the shortest possible time, to the arrangement proposed.

Messrs. White & Co. propose as sub-contractors for the roadwork Messrs. W. Griffiths & Co., and for the special work, as will be gathered from the above particulars, the Lorain Steel Company, of Ohio, U.S.A., and to these arrangements we see no objection. They have not yet indicated to whom they propose to sublet the castings of the yokes and other similar ironwork.

The Bridges Committee of the London County Council received the following tenders for the supply of electric lifts and pumps in connection with the shafts of the Greenwich footway tunnel:—

Easton & Co. (accepted)	£7,334
J. Richmond & Co.	11,375
Scott & Mountain (informal)	—

Reading.—A Manchester contractor, Mr. Nuttall, is stated to have secured the contract for the electric tramways permanent way construction for the Corporation at about £83,800.

Southwark.—The Borough Council has accepted the tender of Messrs. Geipel & Lange for the supply of meters, fuses, &c., for £107.

Stepney.—The Borough Council has ordered certain switchboards from the Ediswan Co. for £1,166.

FORTHCOMING EVENTS.

Thursday, November 14th.—Meeting of the Dublin Section of the Institution of Electrical Engineers. Paper by Mr. P. S. Sheardown on "An Account of the German Tour of the I.E.E."

Friday, November 15th.—At 8 p.m. Electro Harmonic Society. Ladies' night.

Saturday, November 16th.—At 3 p.m. Institution of Junior Engineers. Visit to the Standardising Laboratory of the Board of Trade, Standards Department, Westminster.

Thursday, November 21st.—Opening meeting of the Institution of Electrical Engineers.

NOTES.

Institution of Electrical Engineers (Newcastle Section).—The following is a copy of the programme of Session 1901—1902:—

November 18th.—Address by the chairman, Mr. John F. C. Snell.
December 2nd.—"A Combined Integrating and Maximum Demand Meter," by Mr. J. H. Barker, member.
December 16th.—"Electric Car Equipments and their Maintenance," by Mr. Arthur Wigram, associate.
January 13th, 1902.—"Starting Resistances," by Mr. A. E. Gott, associate.
January 27th.—"Sub-Station Polyphase Machinery," by Mr. Andrew Stewart, member.
February 10th.—"Electrical Legislation and Finance," by Mr. H. W. Handcock, member.
February 17th.—"Equipment of a Modern Telephone Exchange," by Mr. F. A. S. Wormull, member.
March 10th.—"Electrical Power Supply on the North-East Coast," by Mr. C. S. Vesey-Brown.
March 24th.—"The Distribution of Flux in Large Electro-Magnets," by Mr. W. M. Thornton, member.
March 31st.—"Mains Department of a Direct-Current Supply Station," by Mr. J. F. Moore.

The Electrical Operation of Railway Turntables.—The first cost of a steam plant to work a turntable is reported as £250 by the American Association of Railway Superintendents. A gasoline plant costs £200, and an electrical equipment costs £280 with an additional £340 for generating plant. It appears folly to operate electrically, unless current can be had from an existing source. If a separate steam engine must be employed to generate the electricity, why not use the engine direct? The cost of operating turntables by hand and power in a number of cases was respectively 24s. and 30s. per day by hand, and 18s. and 14s. 6d. with gasoline engines. A steam-driven table cost 14s. 6d. by power, and about double this sum by hand. Another steam table cost 19s. 6d. Some electrically-driven tables which had cost 65s. 9d. and 45s. by hand cost 12s. and 18s. 9d. electrically. Other electrically-driven tables cost 30s., 18s. 3d. and 17s. 4d. The number of engines turned per day was from 100 to 400, and does not appear seriously to affect cost. Generally, a gasoline engine is the most economical and convenient, except where electricity can be had from an outside source. Hand power is becoming too feeble for large engines, which now in some cases weigh, including tender, 250,000 lbs., and render some form of power practically a necessity.

Yorkshire College Engineering Society.—The second meeting of the session was held on Monday last week at Leeds. Prof. Goodman, presided; Mr. R. J. Isaacson, read a paper describing the Wigzell balanced engine, which he claimed to be specially suitable for marine purposes, on account of economy of space, light weight, small amount of friction, freedom from crankshaft fracture, and absence of vibration, due to the balancing properties which are its characteristic.

Institution of Junior Engineers.—The annual general meeting of this Institution was held at the Westminster Palace Hotel on October 25th, Mr. Percival Marshall presiding. The report stated that there had been no fewer than 103 elections, bringing up the total membership to 652. In addition to the seven monthly meetings, an additional meeting had been held under the title of "Engineering Question Night," when a number of different engineering questions were dealt with, this new feature in the programme proving very successful. Reference was made to the opening last June of the Institution offices at 39, Victoria Street, the rooms having been suitably furnished as library, reading and writing rooms, &c.

Dispersing Hail Clouds.—In the course of a communication written by Mr. G. W. Stanviéwitch, and read by M. Tanssen before the French Academy of Science, it would appear that the formation of hail at practically any height can be obviated by passing electric sparks through the embryo hail cloud. This can be done by sending up into the cloud a small captive balloon or a kite provided with a steel wire accompanied by two insulated copper or aluminium wires, which would conduct the current from a battery on the ground.

Fair (?) Competition.—We extract the following from the *Financial News*, by their correspondent in Germany:—"The improvement in the steel industry, it is true, is not supported by orders for home consumption; but the exports, especially to Belgium, Holland, and Great Britain, are becoming quite important. At present considerable losses are being sustained on these exports, but they are of great assistance to manufacturers, enabling them to reduce stocks and bringing in much-needed cash. If these exports can only be maintained, they should prove more profitable, as the new contracts for cheaper raw materials and coal will soon come into operation." This is what our manufacturers have to put up with! Happily, no better method could be devised for the eventual destruction of the authors of it.

Royal Institution.—The Christmas course of six lectures to young people at the Royal Institution, will this year be delivered by Prof. J. A. Fleming, F.R.S., Professor of Electrical Engineering at University College, London. His subject is "Waves and Ripples in Water, Air, and Æther," and the first lecture will be delivered on Saturday afternoon, December 28th, at 3 o'clock. The remaining lectures will be on December 31st, 1901, January 2nd, 4th, 7th and 9th, 1902.

London County Council.—The Council resolved, at the meeting on Tuesday, to lend £7,000 to the Poplar Borough Council for the erection of generating station buildings, and £10,000 to the Stepney Council for electric lighting purposes. The consideration was adjourned for a week of a report by the Highways Committee on the subject of the construction of subways for the accommodation of electric tramways and pipes and cables of all kinds. It appears that the electrical engineer and the tramways manager, who recently inspected the shallow underground tramways in New York and Boston, are of opinion that a similar system should be introduced in London. As a trial, it is suggested that a subway and tramway should be constructed from the Victoria Embankment to Theobald's Road or Rosebery Avenue, at a cost of £282,000, and next week the Council will be asked to seek Parliamentary powers for this purpose, and for the placing of pipes and wires in subways. It was decided to apply for powers to authorise the construction of a conduit system of electric tramway from Camberwell Green *viâ* Denmark Hill, Champion Park, Grove Vale, and Lordship Lane, to a point near the intersection of that thoroughfare with Crystal Palace Road.

A 10,000-Volt Shock.—The following "story" is told by the *Sun*:—"An attempt to commit a murder by means of a telephone is reported from Mascara, in Algeria. The manager of the electric lighting station, noticing that his telephone was out of order, attempted to disconnect the wire, and received a violent shock, causing him to fall senseless to the floor. It was afterwards discovered that a discharged workman had connected the wire on the high road with the electric light wire, on which there was a current of 10,000 volts."

Obituary.—The death is announced of Mr. G. Noble Partridge, late superintending engineer of the postal telegraphs for the South Wales district. The deceased gentleman was born in 1842, and commenced his professional career with the old Electric Telegraph Company in 1857. He was transferred to the Government at the time of the acquisition of the telegraphs by the State, and became assistant superintending engineer at Nottingham in 1877. He was made superintending engineer at Cardiff in 1896, and continued in that capacity until February last, when, owing to ill-health, he retired on a substantial pension. It may be added, says the *South Wales Daily News*, that during the five years he was in charge of this district, he superintended many important works, the chief of them being the introduction of the pneumatic tubes between the docks and town offices, and the taking over of the trunk telephone lines from the National Company.

Naval Boilers.—A letter in the *Times* last week from Messrs. John I. Thornycroft & Co., shows the extent to which "Thornycroft" and "Thornycroft-Schulz" water-tube boilers have been adopted in the navies of the world. The following is a list of the countries that have adopted to a certain extent the water-tube boiler:—Great Britain, India, United States, Germany, Denmark, France, Italy, Japan, Spain, Russia, Austria, China, Argentina, Brazil, and Egypt, making a total of 259 ships, and a total collective horse-power of 1,070,440. This includes some of the largest and most powerful battleships and cruisers in existence.

An Effect of Tramway Competition.—In consequence of the success of the new L.U.T. tramways, the L.S.W. Railway are putting on 24 new trains from Gunnersbury to Hounslow, and decreasing the fares.

Institution of Civil Engineers.—On Tuesday last, Mr. Charles Hawksley delivered his presidential address to the members of this Institution, and the presentation of medals and prizes took place.

Electro-Harmonic Society.—On Friday next week (November 15th) there is a ladies' night at the Electro-Harmonic. An excellent programme has been prepared. The vocalists are the Misses Jessie Stewart and Florence Hoole, and Mr. Frederick Ranalow. There will be a silver bell performance by Mr. Harry Tipper, Mr. Albert Fransella, of Queen's Hall fame, is to entertain as a solo flautist, while humorous recitations are to be given by Mr. Arthur Helmore, and humorous sketches by Mr. Harrison Hill. Mr. Izard will be at the piano.

Institution of Electrical Engineers.—It is announced that the annual dinner of the Institution of Electrical Engineers will be held in the Grand Hall of the Hotel Cecil on the evening of Monday, December 9th.

Electromobile Run.—The record of distance for electric motor-cars, held for a considerable time past by Messrs. Bouquet, Garcin and Schivre with 262 kilometres without recharge, has been broken by M. Kriéger, who, on October 16th, with one of his cars carrying a battery of Fulmen accumulators, covered on the "Route Nationale" from Paris to Bordeaux, between Paris and Chatellerault, 307 kilometres without recharge. This is a remarkable performance, which will be learned with pleasure by all interested in the future of "electromobilism." The following statistics regarding this performance are interesting:—

Weight of motor-car (empty) with accumulators	2,225 kilos.
" " (loaded)	2,500 "
" accumulators	1,250 "
Weight of accumulators / Total weight = 1,250 / 2,500 =	·50 "
Initial motive power in volts (60 × 2·5)	150
Mean motive power in volts (60 × 2)	120
Final motive power in volts (60 × 1·7)	102
Capacity in ampere-hours	400
Total energy (about) in kw.-hours	48
Normal speed on level on good surface in km.-hour	26
Corresponding current in amperes (28 to 30)	29
Mean power absorbed (about) in watts (120 × 29)	3,480
Specific energy in watt-hour per car-km.	134
" " " metric ton-km.	53·7
Total distance in km.	307
Total duration of journey, stops included, in hours and minutes	17.35
Total duration of journey, stops deducted, in hours and minutes	15.15
Commercial speed in km.-hours	20
Maximum speed in km.-hours	26
Minimum " " "	13·5

A Telephone Appointment.—"In its endeavours to deal satisfactorily with the public, one of the largest independent telephone exchanges in the country, the Cuyahoga, of Cleveland, has organised a trouble and information bureau, at the head of which it has placed a young lady who has a reputation throughout the State of Ohio for the great success she has achieved in dealing with imbeciles. Probably in making this selection of Miss Ashley, the Cuyahoga Telephone Company had no intention of reflecting upon the average intelligence of the public of Cleveland, but the fact remains that a large percentage of the trouble in giving good service is due rather to the subscriber than to the system."—*Electrical World.*

[Will our own telephone authorities follow suit, and appoint a specialist to deal with those who have become imbeciles while using the service?—Eds. E.R.]

Lifts for Underground Railways.—Our readers are already familiar with the fact that the electric lifts which have been running on the City and South London Railway since the spring of 1960 are of English manufacture, while those on the Central London Railway are of American construction, and have been running since July of the same year. They have, therefore, been at work long enough to afford ample opportunity for a comparison of the advantages of the two systems in actual working. We now learn that the order for the electric lifts for the Great Northern and City Railway, for which the electrical equipment was recently ordered from the B.T.H. Co., has just been placed with Messrs. Easton & Co., Limited. In view of the fact that this firm supplied the City and South London lifts, the order seems to possess a special significance. As statements are constantly being made with regard to the alleged superiority of American machinery over that produced in this country, it is important to note that, as regards lifts, English makers can more than hold their own.

Appointments Vacant.—An electrical engineering demonstrator is required for the Finsbury Technical College at £100 (to £150); a junior assistant for the Darlington Corporation electricity department at £78; a chief engineer-in-charge at £120 and engineers-in-charge at £104 for Bermondsey. The Hackney Borough Council is about to appoint a staff for its electricity works; shift and testing engineers, fitters, and so forth are required, and particulars are given in our "Official Notices" to-day.

Personal.—The Johannesburg *Official Gazette* announces that recently a presentation of an address, accompanied by a gold watch and chain, was made to Quartermaster-Sergeant Devonshire, R.E., by the civilian members of the telegraph, telephone, and engineering branches. The recipient has been acting as district engineer of telegraphs and telephones since the entry of Lord Roberts into Johannesburg. The presentation was made by Mr. J. E. Symons, assistant district engineer, in the presence of some 70 or 80 men belonging to the telegraph and telephone branches.

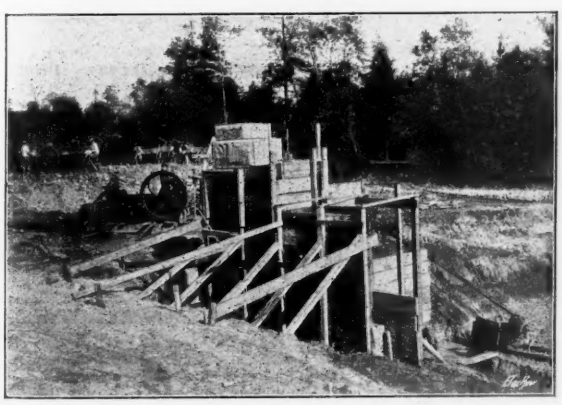
On September 17th the officers and members of the staff of the Brisbane Tramways Company, Limited, gave a farewell send-off to Mr. Harold W. Clapp, superintendent of rolling-stock, who was leaving for the United States to take a position in the works of the General Electric Company at Schenectady. Mr. Clapp has been with the company for five years. He was presented, on behalf of his staff associates, with a handsome set of silver-mounted brushes in a morocco case.

A New York Exchange says that Mr. F. W. Jones, of London, recently visited the United States. Mr. Jones was one of the pioneer telephone men in America before his interests brought him to England.

Agency Notice.—The Thames Electrical Manufacturing Company, of Bucklersbury, E.C., and 110, Cannon Street, are, we understand, taking up several important Continental agencies in electric light fittings and accessories.

For Sale.—Messrs. Wheatley Kirk, Price & Co. announce a forthcoming sale of electric lamps and accessories in connection with the liquidation of the New British Incandescent Electric Lamp Company, Limited. See our advertisement pages to-day.

The Duke of York and the Canadian Niagara Power Works.—Having broken ground for their projected great power development on the Canadian side at Niagara Falls, the Canadian Niagara Power Company hurried preparations forward in order that the corner-stone of their magnificent station, which is to be the scene of Canada's greatest water-power development, and probably the greatest in the English possessions, might be in readiness to be laid by the Duke of Cornwall and York on the occasion of his recent visit to Niagara. Unfortunately the itinerary of the Royal party brought the Duke's visit to the Falls on Sunday, and so it was then impossible for the Duke to place the stone, which means so much for the Dominion and its industrial future. Recognising the merit of the project, and desiring to aid in the noble work of developing Canada's resources, the Duke locked a silver box which was placed in the corner-stone when it was laid in place, as seen in the illustration. The corner of the wheel-pit excavation is seen to the right of the picture. This wheel-pit will have a total capacity of 50,000 H.P., and the first section of it to be built will be 250 ft. long and approximately 200 ft. deep. The pit will contain 5,000 H.P. units. The total projected development of the Canadian Niagara Power Company will be 100,000 H.P. The water



Corner Stone of the Canadian Niagara Power Station.

from the turbines will be discharged into a tunnel that will run to the lower river at a point close to the foot of the Horseshoe Fall. This tunnel is now being built, the contract having been let to Mr. A. C. Douglass, who has had much experience in Niagara tunnel construction. The section of the tunnel will be somewhat larger than the section of the tunnel on the New York side, and it will be lined with brick throughout, as will also the wheel-pit. The length of the tunnel on the Canadian side is about 2,200 ft., as compared with a length of tunnel of about 7,000 ft. on the New York side. The contract for the tunnel calls for its completion by January 1st, 1903, so it is probable that during the latter part of that year Canadian-Niagara will have its first power from the pit. While the Duke of York was at Niagara, he viewed the locality of the Falls and the projected wonderful development with much interest. It will be recalled that the new pit and station are being built in Queen Victoria Free Park, the developed power to be transmitted beyond the park limits.

American Tram Rails and Wheels.—From the discussions of the American Street Railway Convention an interesting item came up in regard to rails. Mr. Beggs, in condemning the demands of the city engineers, who, he said, were usually appointed for political reasons, stated that on his line they used T rails, and they formed the groove by chamfering off the corners of the granite headers and stretchers of the paving. The T rails are laid on 6 in. of concrete. Mr. Beggs appears to come from Milwaukee, where these conditions prevail, and he talked quite feelingly about being compelled to travel alongside the rails. Mr. Beggs may think himself fortunate in not living in England, where more lines of paving are replaced by paving the whole track and even the full width of the street with timber blocks. If a groove in the granite will serve as well as the grooved rail, it certainly seems a waste of money to pay for grooved rails when T rails will serve. Is there any available experience of such paved grooves in England? The Committee on Wheels and Rails recommend the T rails, with wheels having 3 in. treads and flanges $\frac{5}{8}$ in. to $1\frac{1}{8}$ in. Where grooved rails are used the head is to be 3 in. wide, with a groove such that the same car wheel can be employed as that above recommended. Car wheels up to 50 miles per hour are recommended to have plate centres and cast chilled tires. Above that speed steel tires are recommended with tread not less than 3 in. and flanges $\frac{3}{4}$ in. to $1\frac{1}{2}$ in., strengthened on the back. There is a considerable divergence of opinion as to wheels. Mr. Chamberlain, of the Brooklyn Rapid Transit Company, recommends a wheel for city service with an excellent form of flange, which compares favourably with the ridiculous flanges furnished from America. We cannot think that American wheel founders have much experience with grooved rails, for they have sent over to England the most foolish wheel sections. So faulty are these that the flanges strip off in pieces 6 in. and 9 in. long, proving how idle it is to imagine that what is good enough for American requirements will serve our more stringent conditions. The wheel section recommended by Mr. Chamberlain, should weigh 420 lbs. Such a wheel has been found by several roads to be good and economical, and stands high-speed running of 7 or 8 ft. wheel bases round curves more safely than the older wheels of 30 in. weighing, perhaps, only 300 lbs.

Water-tube Boilers.—The Messrs. Niclausse write to the *Times* from Paris to point out that the boilers of the *Leon Gambetta*, the latest French cruiser, are of the Niclausse type, similar to those of our own cruisers *Berwick* and *Suffolk*. The fact is interesting as showing that in the French Navy the Belleville boiler cannot be in such very particular favour as its supporters would fain make us believe. Without claiming, or even admitting, too much for the Niclausse boiler, we may at least admit that it is far superior to the Belleville in safety, and would be easier to make smokeless than the Belleville. It appears that in ships of war there are now 560,000 H.P. of Niclausse boilers in 53 vessels, the French possessing 24 ships so fitted; the United States, six; Britain, four; Russia, four; Germany, two; Japan, three; Italy, three; Spain, three, &c. There should soon be some experience gained of these boilers. The difficulty will be to get at the truth, even when this has been done. In spite of boiler committees the Admiralty seem to be going on with the Belleville wherever they can. Rather perish the empire than that the Admiralty should own up to an error. The latest we see about the condemned Belleville is the statement that the new cruiser, *King Alfred*, launched at Barrow on October 28th, has waiting for her no less than 43 Belleville boilers. It is characteristic of the absolute apathy of the Government where the welfare and safety of the empire are at stake, that this, our largest and latest cruiser, should be put upon the list of inefficients before she is even launched. We do not believe there is a single engineer in the Navy who believes the *King Alfred* will be safe to run many hours at full speed, or that it will prove one whit more successful than those dismal failures *Terrible*, *Powerful*, *Diadem*, and the rest of the band. How long are the Admiralty to be permitted to endanger the Navy by flying in the face of the strongest condemnation of the Boiler Committee? Surely, with the bias that existed on that Committee in favour of the water-tube principle, their condemnation of the Belleville was more than severe; and here are 43 more of them going in, while France will have none them.

THE CENTRAL STATION ENGINEER.

Personal.—The vacant appointment of shift engineer at the Dublin Corporation electricity works has been secured by Mr. C. H. Robinson, of Huddersfield E.L. Station, in succession to Mr. G. D. Gibson, who has secured an appointment in the City of Mexico E.L. Station.

Mr. C. A. Frost, of Darlington, has been appointed assistant electrical engineer at Bexhill Electricity Works.

The Bristol Corporation has appointed Mr. H. H. Couzens as deputy city electrical engineer at a salary of £250 per annum, to be raised to £300 in one year, Mr. Couzens undertaking not to leave before November 1st, 1903. Similarly, Mr. I. H. Bolam has been appointed second assistant engineer at a salary of £200 per annum, increasing to £250, on his undertaking to remain for at least three years.

Mr. H. E. Tatham, engineer-in-charge at the Birkenhead Corporation electric tramway generating station, has been appointed second assistant engineer under the Blackburn Corporation Tramway Department.

On Thursday evening last week, Mr. Campion, assistant electrical engineer at Blackburn, who has just taken up his duties as electrical

engineer to the Dewsbury Corporation, was presented by the staff at the Blackburn works with a handsome travelling bag and dressing-case. The presentation was made by Mr. S. Crossley, vice-chairman of the electrical committee, whose appreciative references to Mr. Campion's ability were endorsed by Mr. Giles, the electrical engineer.

NEW COMPANIES REGISTERED.

Bland Brothers, Limited (71,669).—This company was registered on October 24th, with a capital of £20,000 in £1 shares, to acquire the business of electrical, sanitary, and general engineers, now carried on by William Bland and Alfred H. Bland, as "Bland Brothers," at 147, Barras Bridge, Newcastle-on-Tyne, and Church Street, West Hartlepool, Durham, and to carry on the business of electric wire and cable manufacturers, electricians, mechanical and electrical engineers, galvanisers, annealers, tube manufacturers, electrical and mechanical bell fitters, and manufacturers of, and dealers in, all machinery and appliances used in connection with the generation and supply of electricity. The first subscribers are:—W. E. Bland, The Grove, Benton, sanitary engineer, with 3,250 shares; A. H. Bland, 18, Harrison Road, Newcastle-on-Tyne, electrical engineer, with 3,250 shares; E. B. Downie, The Ashes, Stanhope, engineer, with 500 shares; T. E. Fenwick, Walsingham, Durham, coal owner, with 1 share; Mrs. E. Bland, The Grove, Benton, with 1 share; Mrs. B. E. M. Bland, Mansfield House, Hutton Avenue, West Hartlepool, with 1 share, and J. Fisher, 75, Pilgrim Street, Newcastle-on-Tyne, solicitor, with 1 share. No initial public issue. The number of directors is not to be less than three nor more than five; the first are William E. Bland, Alfred H. Bland, and Ernest B. Downie. W. E. Bland is the chairman; qualification, £500; remuneration for first year, £200 each: subsequent years as fixed by the company. Registered office, 147, Barras Bridge, Newcastle-on-Tyne.

London and North-Western Electric Tramways, Limited (71,717).—This company was registered on October 28th, with a capital of £100 in £1 shares, to construct, maintain and work tramways, light railways, electrical and other railways and motors therefor, with all accessories and appurtenances thereto. The first subscribers (each with one share) are:—A. T. Pendry, 3, Manor Place, Amhurst Road, N., registrar; R. H. Ward, 46, Fetter Lane, E.C., physician; G. C. A. Kohler, Wool Exchange, E.C., merchant, A. O. Bradley, 4, Ingham Road, West Hampstead, N.W., engineer; E. C. Parford, 25, Gilbert Road, S.E., secretary; D. J. Norris, Lyndhurst Cranbourne Road, Muswell Hill, N., clerk; and C. Annesley, 73, Roderick Road, Gospel Oak, N., clerk. No initial public issue. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Thanet Construction Company, Limited (64,065).—Particulars of registered mortgages and charges:—Date of creation of mortgage or charge, November 13th, 1900. The deed is a security for advance without limit. A resolution of the board, dated November 6th, 1900, authorised £125,000 to be borrowed, and another resolution of the board, dated April 14th, 1901, authorised a further £25,000 to be borrowed. Property charged: The present uncalled capital of the company (£150 000), and the amounts now due, or hereafter to become due, from shareholders; the whole of the company's undertaking and property, present and future, including the tramways already constructed, or to be constructed (so far as they belong to the company), any moneys, shares, stock, or debentures of the Isle of Thanet Electric Tramways and Lighting Company, Limited, which the company is entitled to, or will receive, under its contract, dated November 21st, 1899, with the said Isle of Thanet Electric Tramways and Lighting Company, Limited, and any deposits or retention fund to which the company will be entitled on completion of the said contract. Persons entitled to the charge: The governor and company of the Bank of Ireland.

Electric Construction Company, Limited (39,292).—This company's annual return was filed on August 15th, when 31,390 preference and 112,100 ordinary shares were taken up out of a nominal capital of £400,000 in 50,000 preference and 150,000 ordinary shares of £2 each. £2 has been called up on each of 18,245 preference and 2,100 ordinary shares, resulting in the receipt of £40,690. £246,290 considered as paid on 123,145 shares (13,145 preference and 110,000 ordinary). Mortgages and charges—£250,000.

Gorseinon Electric Light Company, Limited (39,944).—This company's annual return was filed on August 12th, when the entire capital of £1,000 in £1 shares had been taken up. 17s. per share has been called up, resulting in the receipt of £850. No mortgages or charges.

Halifax and Bermudas Cable Company, Limited (28,972).—This company's annual return was filed on October 12th, when the entire capital of £50,000, in 10,000 shares of £5 each, had been taken up, all the shares being considered as fully paid. Mortgages and charges, £78,000.

New Rottingdean Electricity Company, Limited (60,173).—This company's annual return was filed on October 25th, when 1,101 shares were taken up out of a nominal capital of £2,000 in £1 shares. £1 has been called up on each share, resulting in the receipt of £1,101. Mortgages and charges, *nil*.

North Wales and District Light Railway and Electric Power Company, Limited (65,824).—This company's annual return was filed on October 10th, when 11 shares were taken up, out of a nominal capital of £1,200 in 12 shares of £100 each. £100 has been called upon each share, resulting in the receipt of £924, and £176 remains in arrears. Mortgages and charges, nil.

SUPPLY STATION ACCOUNTS.

Nottingham Corporation Electricity Accounts.

The results of Nottingham, although not so much talked about as they deserve, are excellent, and, in spite of the slightly increased costs, the net profit last year came out four times what it was the year before. The capital expended during 1900 was considerably more than in 1899, while the output and revenue figures show substantial increases. The units sold now exceed two millions and a quarter. The continuity of policy at Nottingham is all in favour of the undertaking, which takes a high place for all-round efficiency.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£166,098	**£216,126**	£50,028
Number of units sold	1,491,184	**2,312,557**	821,373
Maximum demand in kilowatts ...	1,578	**2,369**	791
Gross revenue	£18,413	**£32,053**	£13,640
Gross expenditure	£8,740	**£14,133**	£5,393
Gross profit	£9,673	**£17,920**	£8,247
Average price per unit sold ...	2·87d.	**3·22d.**	+·35d.

From the revenue statement it will be seen that the average price obtained per unit has increased by slightly more than ¼d., and the return is now nearly 3¼d. The prices charged are numerous: 5d., 4d., 2¾d., 2d., 1½d., and 1d. The ratio of increase in different directions is shown by the following figures:—

Year.	Units generated.	Maximum load kw.	Private supply.	Public lighting.	No. of public arc lamps.
1895 ...	183,694	255	160,090	11,564	8
1896 ...	316,638	400	285,622	11,563	8
1897 ...	511,935	737	468,728	11,653	9
1898 ...	951,319	1,099	875,743	18,931	15
1899 ...	1,603,579	1,578	1,470,280	20,904	15
1900 ...	2,481,168	2,369	2,280,015	32,542	68

Although the increase has been greatest under the head of "Private consumers by meter," the street lighting has been extended, and, no doubt, the movement will continue.

Revenue Statement.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£17,833	2·87d.	**£31,049**	3·22d.	+·35d.
Meter rents	383	·06d.	**543**	·06d.	·00d.
Sale of old material	31	·00d.	**70**	·01d.	+·01d.
Connecting consumers and attending public lamps	166	·03d.	**391**	·04d	+·01d.
Gross revenue ...	£18,413	2·96d.	**£32,053**	3·33d.	+·37d.

The costs show practically no change, except in the first item, where coal has a rise of $\frac{1}{10}$d., and salaries a reduction of $\frac{1}{20}$d., leaving the total costs at still less than 1½d. In the last two years the change has only been from 1·38d. to 1·47d., which compares favourably with most provincial works.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal	£3,643	·59d.	**£6,737**	**·70d.**	+·11d.
Oil, waste, water and engine room stores.	748	·12d.	1,136	**·12d.**	·00d.
Salaries and wages incurred in generation and distribution, and attending public lamps.	1,481	·24d.	2,159	**·22d.**	−·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and street lamps.	684	·11d.	1,218	**·13d.**	+·02d.
Works costs ...	£6,556	1·06d.	£11,250	**1·17d.**	+·11d.
Rent, rates and taxes ..	277	·04d.	372	**·04d.**	·00d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,411	·23d.	1,767	**·18d.**	−·05d.
Establishment charges, stationery and printing, law charges and insurance	496	·08d.	744	**·08d.**	·00d.
Other expenses	—	—	—	—	—
Total costs ...	£8,740	1·41d.	£14,133	**1·47d.**	+·06d.

The revenue increased by £13,640 and the costs by a gross sum of £5,393, thus augmenting the gross profit by £8,247. Of this £1,990 was required to meet additional financial charges, leaving an extra £6,257 under the head of net profits. The total of £8,408 has been divided between the reserve and depreciation funds, which have had £2,408 placed to their credit; the remainder, or £6,000, has been taken towards the credit of the local rate.

Profit Statement.

	1899.	1900.
Interest on loans	£4,347	£6,337
Sinking fund for repayments	3,175	3,175
Net profit carried to credit of general rate	2,000	6,000
" " to reserve fund	—	2,408
" " forward	151	—
Gross profit	£9,673	£17,920

CITY NOTES.

The Monte Video Telephone Company.

The ordinary general meeting of the shareholders of the above company was held on Thursday of last week at Winchester House, Mr. Frank W. Jones presiding.

In moving the adoption of the report, the Chairman said he was pleased to say that the starting of the Port Works at Monte Video was now an accomplished fact. That event happened on July 18th, just at the close of their financial year, when it was made the occasion of a national festival, and if the reasonable expectations that important undertaking had given rise to were ultimately realised great prosperity was in store for the Republic of Uruguay, in which their company could not fail to participate. What especially concerned them at present was that they should make due preparation and be ready to take advantage of the circumstances when they arose. The actual situation to-day was perhaps little changed from a year ago, but what was then stated concerning the probability of their having to make considerable improvements, which events might render not only desirable but imperative, held good with equal force now—with more force, indeed, for they were so much nearer the moment when action must be taken. They were already doing much by way of preparation for an enlarged business, upon which it might not be politic at that time to dwell, but he might say that the board had been actively engaged for a considerable time in the preparation and study of a future programme to meet the prospects of new business, and the changes and advancement in the workings of telephone systems. It was well known that those changes and improvements were revolutionising the business, particularly in the United States, which he had just visited for the purpose of obtaining information on those subjects, and where an enormous increase of subscribers had resulted within the past two years. Heavy capital expenditure was necessary in that connection, and must be looked forward to if their position was to be greatly improved, or even mentioned. There was no such thing as resting in a telephone business movement; retrograde or forward was a certain feature, and in order that it should be the latter, efforts to keep informed of, and in pace with, the constant improvements in telephony must be increasing; and, to take advantage of those improvements at a favourable time, required a command of capital such as in a small company like theirs might not at all times be possible. For those reasons, as stated at their last meeting, the board had adopted the policy of building up a strong reserve, a policy which, he was glad to say, had been approved by the shareholders, and especially by those who had had most to do with telephone companies. It was foreshadowed in his remarks a year ago that a debenture issue to meet the extraordinary expenditure might possibly be made during the year. The time had not been propitious for such an issue, and it had, therefore, been fortunate that there had been no necessity for one, but they should not lose sight of the fact that it might be very desirable to make one at, perhaps, short notice, and they should be so prepared by a strong reserve as not to be forced to make an issue at an unfavourable time. He had spent the past winter in Monte Video, and was pleased to note that their business was a well-established institution, and, in his judgment, only needed the latest appliances to become of very much more value than at present. There was, as was evidenced from the accounts, a steady increase in the business, and it appeared to be well and economically managed. He found that, as was not unusual in South American cities, the action of the governing bodies was not so advanced and liberal as to tend to the rapid extension of telephone service. A similar condition was not unknown with them in England. But he believed more progressive ideas in that respect, as well as in others, would, before long, assert themselves in Uruguay and to the general benefit. With regard to the accounts, there was little requiring comment. The first item in the balance-sheet—capital issued—remained unaltered; secondly, creditors did not represent a large liability, the figure this year, £454, compared with £2,226 last year, which included, it would be remembered, the balance of the purchase price of the new Cordon building, now their unencumbered property. Depreciation fund and reserve fund were as they were left after their last meeting. The last item, profit and loss account, showed the profit for the year, now for the first time expressed in five figures. On the other side of the balance-sheet—capital expenditure, £2,666—was slightly more than last year. Stock of material at Monte Video, £894, was £850 less, and now represented the actual value of the unused material only. Sundry debtors, £2,979, was £665 more, mainly from the increased amount of overdue subscriptions. Investments, £22,079, consisting of real estate in Monte Video, and securities held over here were practically unchanged, the latter item £8,719, represented at current Stock Exchange valuations £10,379. Looking at the profit and loss account, the working expenses at Monte Video were only slightly increased, notwithstanding the substantial increase in subscribers and revenue. London office expenses were about £80 more, and interest and discount £93 more. On the credit side, subscriptions, &c., £20,668, showed an increase of £1,200. The result was a balance of £10,319 net profit, which they might, he thought, consider very satisfactory. With the sum of £1,886 brought in from the previous account, they had a total of £12,205 to be dealt with, and in view of all he had stated, there was no hesitation on the part of the board in deciding that the reserve fund should be substantially added to. It was, therefore, proposed, after paying the same dividend as last year, to place £5,000 to the reserve, carrying forward £1,063. Increased dividends on their ordinary shares might be reasonably expected when they had new capital provided for the requisite improvements and extensions in plant.

Mr. Charles Lock seconded the motion, which was adopted.

The retiring director and auditors having been re-elected, the meeting terminated.

Amazon Telegraph Company.

The report of the directors to be presented at the seventh ordinary general meeting of the company to be held on November 12th, at 11.30 o'clock, at the offices, Moorgate Station Chambers, E.C., reads:—

The directors submit their report and accounts of the company for the year ending June 30th, 1901. The gross revenue amounted to £40,109 7s. 9d., and the total expenses to £36,468 7s. 10d. After charging £9,045 for debenture interest and sinking fund, there is a debit balance of £5,404 0s. 1d., which, added to the debit balance of £63,769 1s. 3d. brought forward from the last account, leaves £69,173 1s. 4d. to be carried forward. The traffic receipts and subsidy both show large increases as compared with the previous year. This arises from the fewer interruptions and better working of the cables. The landline referred to in the last report has been opened and inaugurated by the Manaos Government, and is assisting in maintaining the communication during cable interruptions. In May last the directors entered into a contract with Messrs. Sir W. G. Armstrong, Whitworth & Co., Limited, for the construction of a new cable steamer (twin-screw), specially designed for work on the river Amazon, at a cost of £39,200, complete with all up-to-date cable machinery, &c. This vessel is to be ready in December next, and will be sent out to the Amazon with cable for repairs. As the shareholders are aware, authority was given at an extraordinary general meeting, held after the last annual meeting, to create £150,000 in debentures, ranking in priority to the existing debentures. At a meeting of the debenture holders, held on the following day, February 7th, 1901, this was sanctioned. Arrangements were shortly afterwards concluded for the raising of a loan of £131,250 (on the security of the £150,000 preference debentures) to pay off the loan referred to in the last report (£56,250), and against which 750 debentures of the first issue were held as collateral security, and for the other purposes of the company. This arrangement is now in process of completion, and in due course the £75,000 debentures above referred to will be surrendered, and preference debentures issued against the amounts advanced on account of the new loan. As foreshadowed in the last report, certain changes in the constitution of the board were in contemplation. These resulted in the retirement of Mr. W. S. Andrews, Lord Richard H. Browne, and Mr. John Coppen, and in the election of Mr. E. B. Ellice-Clark and Mr. C. W. Parish. The retiring directors are Mr. E. B. Ellice-Clark and Mr. C. W. Parish, who offer themselves for re-election. The chairman at the last meeting explained that Messrs. Deloitte, Dever, Griffiths & Co. did not seek re-election as auditors, having been appointed accountants to the company. Messrs. Welton, Jones & Co. were appointed auditors in their place. This firm now retires, but is eligible for re-election.

West India and Panama Telegraph Company.

The directors' report for the half-year ended June 30th, 1901, to be submitted to the meeting on November 13th, reads as follows:—

The directors submit the accounts for the six months ended June 30th, 1901. The amount to credit of revenue is £29,145 13s. 5d., against £27,737 17s. for the corresponding half-year of 1900; the expenses have been £21,277 7s. 2d., against £21,731 11s. 10d., leaving a balance of £7,868 6s. 3d., to which is added £2,342 0s. 5d. interest on investments, and £6,670 17s. 4d., the amount brought over from the last account, making a total of £16,881 4s. After the final settlement of the terms of the formal judgment given against this company by the Court of Appeal, in the action brought against it by the Cuba Submarine Telegraph Company, the directors, after much deliberation, decided to lodge an appeal to the House of Lords, which alone could finally clear up the company's position. In their last report and at the general meeting of the shareholders, the directors stated that they thought it prudent, having regard to the pending litigation, and to all the circumstances, to carry forward the balance then shown of £6,670 17s. 4d. to the next half-year's account. The shareholders approved of this policy, and on the present occasion the directors having to deal with the accumulated balance of two half-years, viz., £16,881 4s., recommended the payment in full of the dividend of 6s. per share on the first preference shares for the half-year ended December 31st, 1900, amounting to £10,368 18s., and to carry forward the balance of £6,512 6s. to the current half-year, which, it may be added, is the inactive half of the company's financial year. This will leave still in arrear the dividend on the first preference shares for the six months ended June 30th, and 12 months' arrears to the same date on the second preference shares. There have been certain diminutions in expenditure, and a very small increase in revenue during the half-year under report, but there has practically been no improvement in West India trade, owing to the low price of cane sugar, caused by the system of foreign bounties. It is hoped, however, that at the approaching Conference of European Powers to be held in Brussels for the consideration of the question, the abolition of these bounties may be agreed to. Should such a decision be arrived at, it would greatly tend to benefit the trade of the West Indies, and the business of the company.

Eastern Extension, Australasia and China Telegraph Company.

The report for the half-year ended June 30th, states that the gross receipts amounted to £346,336, against £313,226. The working expenses, including £28,338 for maintenance of cables, absorb £115,781, against £108,660 for the corresponding period of 1900, leaving a balance of £230,554. From this is deducted £6,908 for income-tax, £6,400 for interest on debenture stock, £2,048 for expenses in connection with the new issue of shares, and £175 for subscription to the national memorial to the late Queen Victoria, leaving £215,023 as the net profit for the half-year. Two quarterly interim dividends of 1¼ per cent. each, amounting to £75,000, have been paid for the half-year, leaving an available balance of £140,023, from which £125,000 has been transferred to the general reserve fund, and £15,023 carried forward. During the half-year under review, the company, in conjunction with the Great Northern Telegraph Company, duplicated the Ta-ku—Chifu section of the international cables, which they established to the north of Shanghai in the autumn of last year. Partial renewals of the cables between Singapore, Malacca, and Java were also carried out during the half-year, and the cost, amounting to £7,810, has been charged against the general reserve fund. The company's expenditure on account of the Cape—Australian cable up to June 30th, amounted to £583,241, of which £125,137 was debited to the general reserve fund last year.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—British Westinghouse Electric and Manufacturing Company, Limited, further issue of 50,000 6 per cent. preference shares of £5 each, fully paid; Calcutta Electric Supply Corporation, Limited, further issue of 10,000 shares of £5 each, fully paid, Nos. 201,000 to 30,000; Charing Cross and Strand Electricity Supply Corporation, Limited, £250,000 4 per cent. debenture stock (redeemable), in lieu of the provisional certificates now quoted.

Castner-Kellner Alkali Company.—The directors have declared a dividend for the six months ended September 30th at 4 per cent. per annum.

New Issue.—The Poole and District Electric Traction Company, Limited, offers for subscription the balance of 2,793 unissued ordinary shares of £10 each at £11 per share. The issue is being made to discharge the remaining debt on the construction of the line.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Nov. 2nd were £514; corresponding week last year, £438; increase, £76. Total to date, £22,273, corresponding period last year, £19,788. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending November 2nd were £248; corresponding week last year, £205; increase, £43. Total receipts to date, £19,661; corresponding period last year, £19,087; increase, £574.

Bristol Tramways and Carriage Company.—The receipts for the week ending November 1st were £3,942; corresponding period last year, £2,897, increase, £1,045.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending November 1st:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon	609	342	—	44	14,033	862	—
Devonport ..	377	—	—	19	7,638	—	—
Dudley—Stourbridge	700	159	—	44	29,141	15,451	—
Gateshead	603	—	—	25½	14,987	—	—
Greenock-Pt. Glasgow	167	—	—	4	764	—	—
Hartlepool	222	35	—	44	10,080	1,277	—
Kidderminster ..	101	14	—	44	5,474	667	—
Merthyr	205	—	—	30	7,780	—	—
Middleton	—	—	—	—	—	—	—
Oldham—Ashton ..	500	500	—	44	22,115	3,225	—
Poole	224	—	—	30	8,938	—	—
Potteries	1,456	230	—	44	61,601	18,580	—
Southport	141	—	19	44	7,372	—	2,686
South Staffordshire	305	83	—	44	34,808	2,515	—
Swansea	424	36	—	44	19 511	4,220	—
Taunton	66	—	—	10½	1,001	—	—
Tynemouth	185	—	—	32	9,387	—	—
Wolverhampton Dist.	86	32	—	44	2,855	624	—

Central London Railway.—The receipts for the week ending Nov. 2nd were £6,629; corresponding week last year, £6,564 (includes C.I.V. day, 1900); increase, £65. Total receipts from July 1st (18 weeks), £107,002. Miles open, 6.

City and South London Railway.—The receipts for the week ending Nov. 3rd were £2,111; corresponding week last year, £1,936; increase, £175. Total from July 1st to date, £34,665; corresponding period last year, £28,394; increase, £6,271. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending November 2nd were £197 14s. 9d.; corresponding week last year, £187 17s. 2d.; increase, £9 17s. 7d. Total to date, £7,762 14s. 9d½.; corresponding period last year, £7,375 5s. 1½d.; increase, £387 9s. 8d. Miles of track open, 3; Car miles run, 1901, 5,325; 1900, 4,968. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending November 1st were as follows:—D.U.T. Co., electric cars, £3,532 2s. 0d.; D.S.D. Co., electric cars, £766 3s. 5d.; total, £4,298 5s. 5d.; corresponding period last year—D.U.T. Co., electric cars, £3,422 19s. 5d.; ditto, horse cars, £25 12s. 6d.; D.S.D. Co., electric cars, £686 0s. 11d.; total, £4,134 12s. 10d.; increase, £163 12s. 7d.; aggregate to date, £87,617 9s. 10d.; aggregate to date last year, £86,304 8s. 3d.; increase, £1,313 6s. 7d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and two miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending November 3rd were £1,445; corresponding week last year, £1,561; decrease, £116. Total from July 1st to date, £29,3?5; corresponding period last year, £30,455; decrease £1,120. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Uncertainty is the keynote of the Stock Exchange situation. A 4 per cent. Bank Rate and a sharp fall in Consols are not conducive to strength of markets, and Sir Michael Hicks-Beach hints in no dark fashion at the certainty of more war money being wanted in the near future. The South African imbroglio still involves everything in depression, and what we overheard an officer at the Naval and Military Club refer to as "the seven years' war" shows very little sign of coming to an end. But the fog has helped the electricity supply section quite considerably this week, and the anathematised atmosphere deserves charitable consideration at the hands of certain shareholders. The railway department is dull, under the influence of dearer money and collapsing Consols, while telegraph securities are inclined to flabbiness, notwithstanding the excellent report just issued by the Eastern Extension Company.

City of London Electric Lighting shares are £1 better, and are actually buyers at a fraction over the middle price quoted by the misleading Official List of the Stock Exchange. It was reported on Tuesday that the company had "sold seventeen hundred pounds worth of current" during the foggy hours of Monday. As nobody contradicted the vague statement, it was allowed to pass muster, and assisted in the promotion of the rise in price. Countys also hardened, it being reported that the new issue of Preference was well taken, and Charing Cross Preference easily regained the fraction shed last week. Westminsters, after their dull days, are ½ up, and the fog is said to have proved a perfect windfall—to mix a metaphor—to the company. Quiet investment buying is noticeable in the supply market, but there remains a certain amount of Metropolitan 3½ per cent. Debenture on offer, and the stock is a point lower.

Central London descriptions have received a gentle check to their upward career, and the Ordinary stock is a trifle lower on the week. We would remind the board that if the line is to maintain its wonderful popularity, the officials must see that the ventilation is kept up to a proper standard. Those who have travelled by the Tube for the last 12 months have reason in declaring that the atmosphere is not as fresh as it used to be at first, and every well-wisher of the company will hope to see the undertaking kept thoroughly abreast of the public's comfort and requirements. Last week's traffic appears a poor one at first sight, but as it goes against the period which embraced C.I.V. day last year, the figures are really good. City and South London stock is waking up, and we would reiterate our opinion as to the probability of a rise coming before long. Metropolitan Consolidated at 7¼ and District Ordinary at 26¾ pursue the even tenor of their downward way, undisturbed by the sittings of the Arbitration tribunal. Of the numberless schemes now being hatched for covering the country with "Tube" lines, none of the latest have entered into Stock Exchange practical politics, but the introduction of shallow-tunnel trams worked by electricity is a subject of considerable interest to the House. To illustrate the scope there is for improvement of shareholders' stakes in tramway shares, we may mention that the £10 fully-paid Ordinary of the South London Tramways stand at £4, the fully-paid £4 shares of the London Street Tramways are only 1½, while the £5 shares, also fully paid, of the London, Deptford and Greenwich Company are round about 25s.

As regards the electric traction tramway shares, Blackpool and Fleetwood (£10 nominal) are 13½, Dublin United Ordinary, of the same denomination, are 12, while London United 4 per cent. Debenture stock commands five points premium.

British Electric Tractions have not recovered their last week's drop, but keep hard at 14, the Preference being 12. New General Traction Ordinary and Preference languish at 3 and 4 respectively, and the 5 per cent. Mortgage Debentures are precisely par. Potteries Electric Traction Ordinary are comparatively lifeless at 12, and the Preference stick at 10. There is no quotable change in colonial and foreign tramway varieties.

Telegraph issues are heavy, without any noteworthy feature. The capital report of the "China" Company, already referred to, has produced no effect, perhaps because the market was expecting something favourable. Beyond an insignificant fall of 1 per cent. in Eastern Ordinary and Eastern and South African (Mauritius) Debentures, there is no change in this section. The American descriptions are unaltered, business in them being reduced to little more than a small market inquiry for Anglo-American Preferred stock. West Coast of America shares are cautiously widened in quotation on account of the wonderful progressiveness shown in all departments of American commerce, but Submarine certificates are the same price as last week and the week before that. Globe Ordinary and Preference show a slight rescission, restoring the Ordinary to its former quotation.

National Telephone Ordinary and third Preference shares are down again to a small extent, but the 4 per cent. Debenture stock is being bought, as we said it deserved to be, and the price is a point nearer par at 98½. It is certainly worth another 4 per cent. United River Plate telephones are ¼ easier at the prospect of internal trouble in the country, but the fears have not affected Monte Video telephone shares.

Yet another relapse has carried British Aluminium Preference to 3½, and the Industrial brigade is generally dull, India-rubber shares alone excepted. Brush Preference are down ⅛, and Telegraph Constructions have lost a £1. Babcock & Wilcox are steady at 2¾, but at 10½ Willans & Robinson are a shade easier.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Oct. 30th.	Closing Quotations Nov. 6th.	Business done during week ended Nov. 6th, 1901. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	98 —101	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 ...	10	...	...	...	—	3½— 4½	...	...
119,700*l*	Amazon Telegraph 5 % Debs., Nos. 1 to 1,200 Red.	100	...	...	...	78 — 83	78 — 83	80	...
804,720	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	52 — 55 xd	52 — 55	...	...
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99 xd	97 — 99	99	97¾
3,097,640	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	9¾— 10½	9¾— 10¼	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,741,029*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	102	101¾
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6 xd	5 — 6	5⅜	...
6,000	Do. 10 % Pref.	10	10 %	...	...	13½— 14½	13½— 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4 xd	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000*l*	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	...
60,710*l*	Direct United States Cable	20	3½%	3½%	3½%	10½— 11½	10½— 11½	10⅛	...
104,300*l*	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	138 —143	137 —142	140½	138
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	94 — 97	94 — 97	94½	
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	115½	114
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅜— 14¼	13⅜— 14¼	14⅛	13⅜
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	113 —118	113 —118	114½	...
300,000*l*	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼%	...	100 —103	100 —103	100	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104 %	101 —104 %	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	11¼— 11⅜	11 — 11¼xd	11 7/16	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	...	...	15 — 15½	14⅜— 15½	14⅞	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	29 — 31	29 — 31	29⅞	...
78,000*l*	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	40 — 44 xd	40 — 44 xd	...	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅜— 1	⅜— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	4¼— 4½	4⅛— 4⅜	4 1/16	4 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	12½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅝— 4⅞	4⅝— 4⅝	4⅝	...
2,000,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	96½	96
500,000*l*	Do. 4 % Deb. Stock Red.	100	...	...	4 %	96 — 99	97 — 100	99¼	98¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	1 1/16— 1 1/16xd	1/16— 1 1/16	1	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,203	Submarine Cables Trust	Cert.	...	...	...	125 —130 xd	125 —130	127½	126½
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5½	4¾— 5¼	5 1/16	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4¾— 5¼	4¾— 5¼	...	...
179,947*l*	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	102	...
125,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	99½	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ½	¼— ¾	...	...
150,000*l*	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½— 15	14½ - 15	14¾	14½
75,000*l*	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	103 —106	103 —106	...	...
348,777*l*	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	¼— ½	¼— ½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	5 9/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	... — ...	⅝— ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	... — ...	97 — 102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	...	...
10,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¼— 8⅝	8¼— 8⅝	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	..	...
50,000	Do. do. do. do 4½%, Cum. Pref.	5	...	...	...	5 — 5½	5¼— 5⅝	5⅛	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	... — ...	104 —106	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5½— 6	5 — 5½	...	...
150,000*l*	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8 — 9	9 — 10	9	8¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11½— 12½	11½— 12½	...	...
400,000*l*	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅛	12 1/16
400,000*l*	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	104 —107	104 —107	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½— 6	5½— 6	5⅞	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6	...	...
120,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	106½—106¼	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	..
250,000*l*	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	..	
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13 — 14	13⅜	13 9/16
220,000*l*	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	113 —116	113 —116	...	...
250,000*l*	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	96 — 99	...	...
8,652	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	15⅝	15½
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	..	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	8 11/16	...
150,000*l*	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000*l*	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3	2½— 3	...	...
109,518	Westminster Electric Supply, Ord.	5	12 %	13 %	10½%	11 — 12	11½— 12½	12⅛	12

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Oct. 30th.	Closing Quotation Nov. 6th.	Business done week ended Nov. 6th, 1901. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	5½ — 6½	5 — 6	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91 xd	87 — 91 xd	...	...
62,074	British Electric Traction	10	6 %	8 %	9 %	13½ — 14½	13⅝ — 14⅛	14⅛	14¼
9,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11⅝ — 12¼	11⅝ — 12¼	12¼	12⅛
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	121 —124	121 —124	122⅜	121¼
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	8 — 9	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 5⅝	5½ — 5⅝	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞ — 1	⅞ — 1	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	...	6 %	1 1/16 — 1 1/16 xd	1 1/16 — 1 1/16	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	4 %	5½ %	5 %	1⅝ — 1⅝	1⅝ — 1⅝	1 7/16	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	2 — 2¼	1⅝ — 2⅛	2 1/16	1 15/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	16 — 17 xd	16 — 17 xd	16½	16 1/16
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	107 —110	106 —109	109	107½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 —108	107½	107
440,100	Do. do. Def. do.	Stock	...	...	...	105 —108	105 —108	106½	106¼
855,000	City and South London Railway	Stock	2⅛ %	1⅞ %	1⅛ %	51 — 54	51 — 54	53⅛	53
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	10	...	...	...	5 — 5¼	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½ %	8 %	3 — 3½	3 — 3½	...	...
100,000*l*	{ Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red }	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½ %	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½ %	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85	81½	80
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89 xd	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅝ — 2¼	1⅝ — 2¼	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	7 %	...	...	2⅓ — 3	2⅓ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	10 — 10½	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16 — 17	16 — 17	16½	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½ %	4½ %	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	22 — 23	22½ — 23½	22 1/16	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103 xd	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼ %	3⅜ %	3½ %	6 1/16 — 6 3/16	5½ — 5⅝	...	...
10,000	† Do. do. Pref., £10 paid ...	10	5 %	5	...	13 — 13½	12½ — 12⅝	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	15½ — 16½	15½ —16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½ %	38 — 42	37 — 41	39⅜	38⅛
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	104 —106	104 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	92½	91

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 2/— 4/-
National Electric Free Wiring, 17/6 paid, ½—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10⅜.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, November 6th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	80/-	80/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a " " ..	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a " (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¼d.	8¼d.	..
a " Caustic (75/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	105/-	95/-	10s. inc.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb.	2½d.	2½d.	¼d. dec.
METALS, &c.				
Aluminium Ingots, in ton lots	per ton	£148	£148	..
" Wire, in ton lots	per ton	£224	£224	..
" Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 9" to 12") basis	per lb.	7¾d.	7¾d.	..
Tube (brazed)	per lb.	9½d.	9½d.	..
" " (solid drawn) ..	per lb.	8½d.	8½d.	..
" Wire, basis	per lb.	7¾d.	7¾d.	..
Copper Tubes (brazed) ..	per lb.	10d.	10d.	..
c " " (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£80	£80	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£80	£80	..
g " Rod	per ton	£80	£80	..
e " (Electrolytic) Bars ..	per ton	£82	£82	..
e " " Sheets ..	per ton	£90	£90	..
e " " Rod ..	per ton	£84	£84	..
e " " H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	8/6½ to 3/7½	3/6½ to 3/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) ..	per ton	44/1½	44/9	7½d. dec.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
i " Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£11 15 to £11 17 6	£11 12 6 to £11 15	2/6 inc.
g " " Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/8	1/0½ to 1/8	..
p " rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " " strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	£10	..
i " " in bars		£58	£58	..
g Tin, block	per ton	£116 to £117	£116 10 to £117 10	10s. dec.
g " foil	per lb.	1/6	1/6	..
n " wire, Nos. 1 to 18	per lb.	1/7	1/8	1d. dec.
p White Anti-friction Metals —				
"White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j " 6 lea. Flax	per lb.	5½d.	5½d.	..
j " 3 ply 10 lbs. Russian ..	per lb.	4¼d.	4¼d.	..
j " 10 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j " 180 lbs. Jute rove	per ton	£10 5	£10 5	..
k Zinc, Sh't. (Vielle Montagne brd.)	per ton	£22 10	£22 10	..

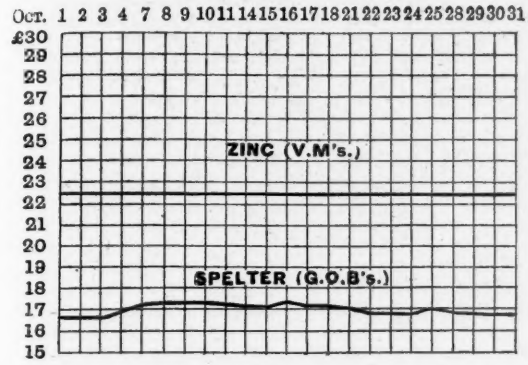
Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co.

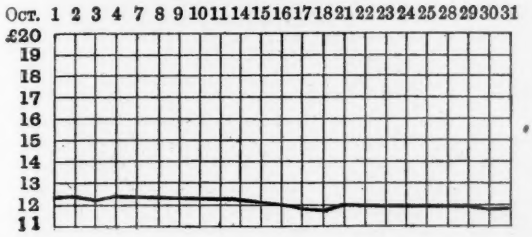
Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

METAL MARKET.

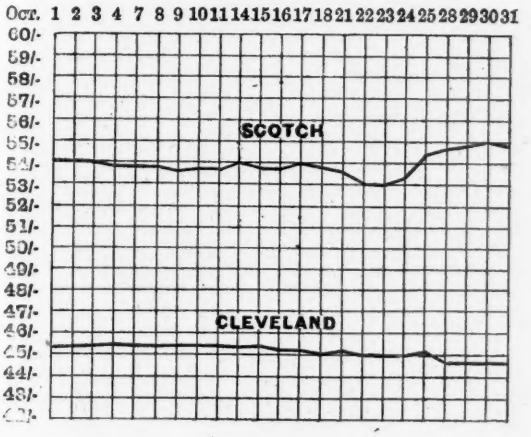
Fluctuations in October.



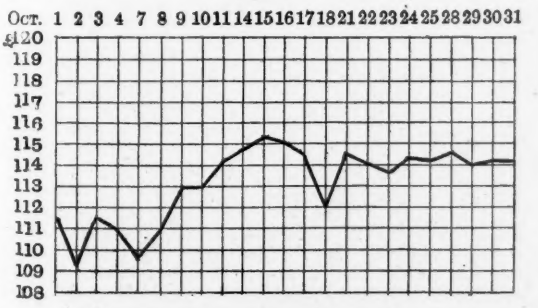
LEAD (ENGLISH).



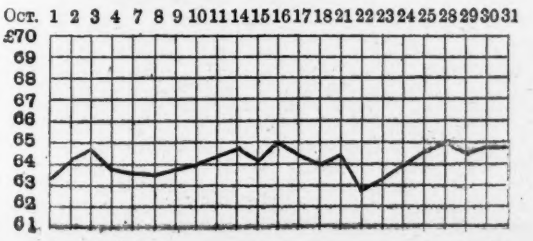
IRON.



TIN.



COPPER (G.M.B's.)



THE INTERNATIONAL ENGINEERING CONGRESS OF 1901.

MODERN COMMUTATING DYNAMO MACHINERY.

(Abstract of Paper read before Section IX. by H. M. Hobart, M.I.E.E.)

(*Concluded from page* 730.)

In the specifications in Tables XX., XXI., and XXII. are given more complete data of the writer's designs for slow speed direct-connected units of 400 kw., 1,000 kw., and 1,600 kw. The guarantee to which they comply is as follows:—

Guarantee: 25 per cent. overload during one half-hour, without harmful sparking or heating. Thermometrically measured temperature increase not over 50° C. above surrounding atmosphere, during continuous operation at rated load. No harmful sparking or heating with momentary overloads of 50 per cent. Fixed brush position for all these conditions. Insulation of entire machine from copper circuits to iron, to withstand the application of a R.M.S. potential of 4,000 volts for one minute at 20° C.

Table XX.

Specification.	400 kw.	1,000 kw.	1,600 kw.
Number of poles	8	16	22
Kilowatts rated output	400	1,000	1,600
Speed—revolutions per minute ...	100	90	85
Full load voltage	550	500	550
Full load amperes	730	2,000	2,900
External diameter of the armature (centimetres)	230	350	450
Length armature over winding (centimetres)	95·0	80·0	72·0
Length over armature core (centimetres)	40	35	33
Number of ventilating ducts	8	8	7
Width of each duct (millimetres) ...	13	13	13
Effective length of laminations in armature core (centimetres)... ...	27	22·5	21
Internal diameter of armature laminations (millimetres)	140	281	375
Diameter of commutator (centimetres)	165	270	350
Length of commutator (centimetres)	32	38	27
Width of segment at surface (excl. insulation) (millimetres)	6·6	7·4	7·6
Thickness of insulation between segments	0·76	0·76	0·76
Total number of segments	792	1,152	1,320
Total number of slots	264	384	440
Segments per slot	3	3	3
Turns per segment	1	1	1
Width of slot (millimetres)	12·3	13·4	14
Depth of slot (millimetres)	33	32	34
Radial depth of air-gap (millimetres)	9	10	10
Radial length of magnet core (centimetres)	45	48	50
Diameter of magnet core (centimetres)	45·5	38·0	38
Cross-section of magnet core (square centimetres)	1,630	1,140	1,130
Pole-face dimensions (centimetres) ...	40×61	35×49	33×47
Ratio of pole arc to pitch	0·67	0·71	0·72
External diameter of magnet yoke (centimetres)...	379	531	644
Width of magnet yoke (centimetres)...	66	70	90
Radial thickness of magnet yoke (centimetres)	21	30	38
Width of armature conductor (millimetres)	2·4	2·8	3·0
Height of armature conductor (millimetres...	13	12·5	13·5
Current density in armature conductor (amps. per sq. centimetre)	303	357	330
Thickness of armature slot insulation (copper to iron) (millimetres) ...	1·6	1·6	1·6
"Space factor" in armature slot ...	0·46	0·49	0·51

The practicability of obtaining good results as regards sparking in large high-speed dynamos, for direct coupling to high-speed engines, is purely a question of adopting sufficiently solid mechanical construction throughout, to permit of an absolutely true running commutator of high peripheral speed, both commutator and brush supports being completely free from vibration. Take, for instance, a large 500-volt unit, which would be the most difficult case for high speed. With a sufficiently large commutator diameter and sufficiently narrow segments, there may be high armature strength per pole. The high speed, high armature strength per pole, together with a rather large number of poles, will result in requiring but a very small magnetic flux per circuit, and hence the machine will be very narrow. A narrow machine with many segments per pole, and consequently low average voltage per segment, will also, in spite of the high commutation frequency, be characterised by low reactance voltage, which, with the stable mechanical construction above set forth, will result in a machine with excellent commutating properties. Indeed, it occurs to the

writer to point out here that probably one of the most characteristic novelties of his designs—if such slight departures from preceding designs may be termed novelties—consists in the employment of fairly many poles combined with high armature strength per pole. There appears to be a large field for such machines, which is developing as a result of the success which has been achieved with large high speed engines. The possible economies may be judged by explaining that, for a given output, the factory cost for large 500-volt direct-connected dynamos decreases closely in proportion to the square root of the ratio of the speeds. This is no theoretical deduction, but the result of comparisons of the complete factory costs of a number of such machines. For lower voltage dynamos the saving would not be quite so great as in this proportion

Table XXI.

Specification.	400 kw.	1,000 kw.	1,600 kw.
Average voltage per commutator segment	5·6	7·7	9·2
Amperes per sq. cm. of brush contact	5·0	5·0	5·0
Total reaction in armature ampere-turns per pole	9,000	9,000	7,900
Type of winding	8-Circ. single	16-Circ. single	22-Circ. single
Paths through armature winding from positive to negative brushes	8	16	22
Amperes per path	91	125	132
Length of arc of brush contact (millimetres)	23	20	33
Frequency of commutation, cycles per second	190	318	236
Mean length of armature turn (centimetres)	300	240	220
Embedded length per turn (centimetres)	54	45	42
Reactance voltage with full load amperes	2·8	3·9	3·7
Apparent tooth density (lines per sq. cm.)	21,000	22,700	23,000
Width of tooth at root (millimetres)	14·3	14·7	17·6
Radial depth laminations below slots (centimetres)	42	31	34
Density below slots (lines per sq. cm.)	10,300	10,700	10,700
Cycles per second for reversal of magnetisation in armature iron	6·7	12·0	15·6
Total arm. flux at full load and rated terminal voltage (megalines)	21·7	14·9	15·1
Assumed factor for magnetic leakage	1·125	1·125	1·125
Flux in magnet cores (megalines)	24·4	16·8	17·0
Density in magnetic cores (lines per sq. cm.)	15,000	14,900	15,000
Density in magnet yoke (lines per sq. cm.)	11,100	4,000	5,400
Pole-face density (lines per sq. cm.)	8,900	8,700	9,900
Ampere-turns on open circuit but full load voltage	10,000	11,000	13,000
Ampere-turns at full load amperes and volts	13,500	14,000	16,000
Ampere-turns for overcoming armature reaction	3,500	3,000	3,000
Material of magnet yoke	Cast-steel	Cast-iron	Cast-iron
Material of magnet cores	Cast-steel	Cast-steel	Cast-steel
Material of magnet pole-faces	Cast-iron	Cast-iron	Cast-iron
Material of armature sheets	Steel	Steel	Steel
Peripheral speed of armature (metres per second)	12·0	16·5	20·0
Peripheral speed of commutator (metres per second)	8·7	12·7	15·6
Centrifugal force at armature surface in kilogrammes per kilogramme	13·0	16·0	18·0
Centrifugal force at commutator surface in kilogrammes per kilogramme	9·0	12·0	14·0

The speeds are just about such as are very suitable for large, 25-cycle rotary converters; and it is distinctly economical, where no especial advantage is thereby sacrificed, to develop both of these classes of apparatus from the same models. Thus a 25-cycle, 400-kw., 500-volt, 6-phase rotary converter works out very finely with 8 poles and 375 r.p.m., and this speed, with shortened commutator, yields an excellent 300-kw. dynamo. Similarly a 10-pole, 650-kw., 500-volt, 300 r.p.m., 6-phase rotary converter, with minor changes, yields an excellent design for a 500-kw. dynamo for the same voltage and speed.

It is probably not generally realised what a stupendous programme of ratings requires to be standardised—in continuous-current machines alone—by every large electrical manufacturing concern. We may consider the case of a single line of very small high-speed machines of from 125 kilogrammes weight, up to 2,600 kilogrammes weight. This may be provided for by some 12 distinct models, but when worked out to meet the demands of the market, with ratings as dynamos, motors, and all the sub-divisions of these two classes, the list is found to comprise hundreds of ratings for which but few can, with any regard to the best results, be arranged to have precisely the same manufacturing specifications.

It is scarcely to be wondered at that the large manufacturer, confronted with the task of standardisation, is inclined to demur at the multiplicity of patterns, drawings, dies, gauges, winding forms, insulation moulds, &c., required for securing the best results.

The engineer who proposes to urge the further complications, from the standardising standpoint, which are required in conscientiously applying the knowledge of the subject nowadays at his disposal, calling for commutators and windings proportioned with due regard to the conditions which should be complied with, has no easy task, and the smaller the machines the more unwelcome are his proposals.

Table XXII.

Specification.	400 kw.	1,000 kw.	1,600 kw.
Losses and Efficiencies at 60° C.			
Core loss	9,000	18,000	32,000
Armature copper loss	13,100	24,200	24,400
Commutator C^2R loss at brush contacts	16,000	4,400	5,800
Allowance for stray losses in commutator	100	200	300
Commutator brush friction loss	700	2,800	5,300
Loss in shunt winding	4,400	8,250	13,000
„ series „	1,600	2,250	3,000
„ shunt rheostat	650	1,250	2,000
„ series diverter rheostat	600	750	1,000
Total of constant losses	14,850	30,500	52,600
„ variable losses	16,900	31,600	34,200
„ all losses	31,750	62,100	86,800
Commercial efficiency at full load	92·6	94·1	94·9
„ „ „ ¾ „	92·5	94·0	94·4
„ „ „ ½ „	91·4	92·9	92·8
„ „ „ ¼ „	86·4	88·5	88·1

The commutator losses are figured on a brush resistance of 0·2 ohm per square cm., a brush pressure of 0·1 kg. per square cm., and on a friction coefficient of 0·3.

Watts per sq. decimetre of peripheral radg. surface of armature at 60° C.	31	48	57
Watts per sq. decimetre of peripheral radg. surface of commutator at 60° C.	17	25	43
Watts per sq. decimetre of exter. cylindrical radg. surface of field spools at 60° C.	9	9	9

Weights and Costs in Kilogrammes and Shillings.

Armature laminations	5,500	5,300	7,700
„ copper	660	900	1,100
Commutator segments	730	1,700	1,700
Field copper	900	1,570	2,700
Pole faces	700	1,000	1,200
Magnet cores	4,300	7,000	10,000
Total magnet yoke (including feet)	12,400	27,000	33,000

Taking for costs per kilogramme, the rough values of 2 shillings per kg. for copper, 0·31 for laminations, 0·38 for cast-steel and 0·25 for cast-iron, the totals for the cost of "net effective material" are:—

Total cost of "net effective material" in shillings	12,800	19,500	25,800
Total weight of complete machine exclusive of shaft (kilos.)	32,000	62,000	77,000
Cost of "net effective material" per kw. in shillings	32·0	19·5	16·1

In the other extreme case, namely, that of very large units, the contrary conditions prevail, and the engineer's task is a relatively easy one.

Even when the manufacturer considers it expedient in machines of from 2 h.p. to 75 h.p. to evolve them, to the detriment of their technical properties, out of a minimum number of drawings, patterns, and dies, the necessities of special cases will compel the manufacturer to depart gradually from the original set of standardised designs, and accumulate an irregular assortment of deviating designs, most of which will be discreditable makeshifts. This result is in striking contrast to that to be obtained by boldly accepting the situation in the first place, making each machine correct for its rating. *Then*, when the inevitable necessity arises of supplying special machines, these will be developed from whichever one of a very large variety of *correct* designs most nearly corresponds to the special requirement, and much greater satisfaction and economy will be secured.

The writer inclines to the belief that at least a little more regard for technical excellence in the types of machinery treated of in this paper, may perhaps be consistent with the commercial success of the concerns engaged in their manufacture.

ENGINES FOR DRIVING LARGE DYNAMOS.

Read Saturday, October 12th, 1901, before the Manchester Association of Engineers, by CHAS. DAY.

(*Concluded from page* 733.)

Valve Gear.

The whole of the valve gear is centralised in a box midway between the cylinders. Seen open, this box looks somewhat complicated. On second thoughts it will be appreciated that there is really no more complication than with a Corliss engine if the wrist plates, valve levers, dash pots, trip levers, &c., were, instead of being fixed separately on the cylinders, gathered together midway between them and enclosed in a box. The object of this enclosing is to enable the valve gear to be flooded with oil.

The valve spindles are operated by means of cams, which cams revolve at half the speed of the engine. The arrangement for driving the exhaust valves is illustrated diagrammatically (fig. 2).

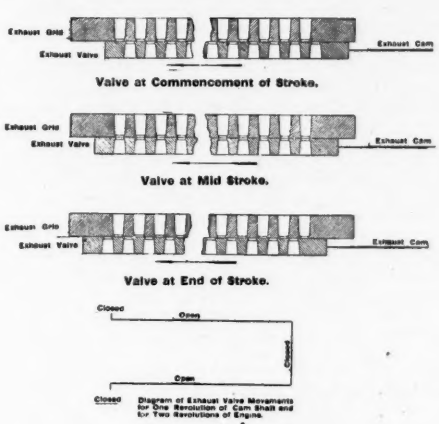

Exhaust Grid
Exhaust Valve
Exhaust Cam
Valve at Commencement of Stroke.
Valve at Mid Stroke.
Valve at End of Stroke.
Closed
Open
Diagram of Exhaust Valve Movements for One Revolution of Cam Shaft and for Two Revolutions of Engine.

Fig. 2.

By this arrangement a very easy motion of the valve is obtained, and the connection between the cam bridle and the valve is an absolutely straight one, there being no moving joints or pins.

The arrangement for driving the steam valves is slightly different, owing to the necessity for obtaining automatic expansion. Each steam valve has two cams, one being the opening cam, and the other the closing cam. The opening cam has a fixed angle of advance and thus gives constant lead. The cut-off cam has its

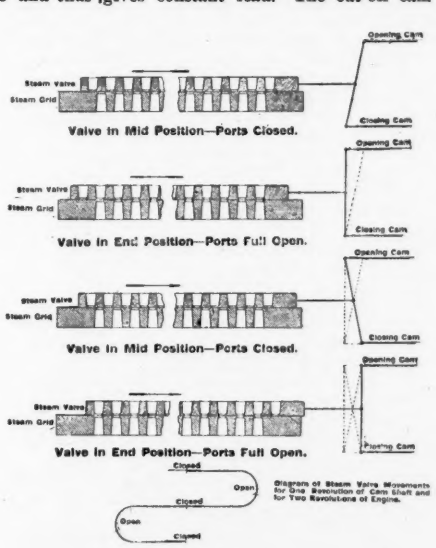

Steam Valve
Steam Grid
Opening Cam
Closing Cam
Valve in Mid Position—Ports Closed.
Valve in End Position—Ports Full Open.
Valve in Mid Position—Ports Closed.
Valve in End Position—Ports Full Open.
Closed
Open
Diagram of Steam Valve Movements for One Revolution of Cam Shaft and for Two Revolutions of Engine.

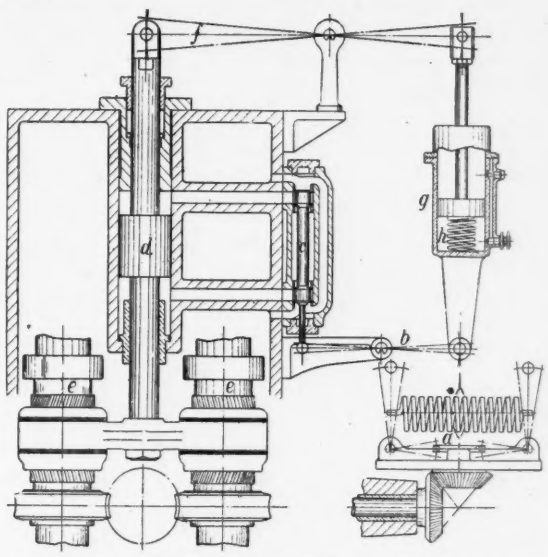
Fig. 3.

angle of advance variable by means of the governor, and thus cuts off earlier or later. The action is illustrated by fig. 3. The angle of advance of the closing cam is adjusted by means of a spiral or scroll, this scroll being lifted or pushed down by the relay piston, which in turn is controlled by the governor.

A particular feature of the cams, to which I would draw your attention, is that they are constant in diameter, that is to say, the distance between the cam rollers is quite fixed. The method in practice of securing absolute uniformity of diameter is by testing the cams in a sliding frame carrying fixed rollers. The equality of diameter is further illustrated in the model on the table. This arrangement makes it possible to drive valves positively by cams in two directions, thus doing away with the spring return usual with cam gears. The cams have a positive push and pull, but in addition a spring is arranged which allows the rollers to remain in contact with the cam in case of any slight irregularity in diameter or in case of slight wear of the cam.

Governor.

The arrangement of the governor and its connections is also of considerable interest, and shows one solution of the problem of governing, by automatic expansion, engines of large powers, and of speeds too high for trip gears, as with this arrangement there is absolutely no limit to the size of engine which can be thus governed.



a, Governor; *b*, Governor lever; *c*, Controlling valve; *d*, Relay piston *e*, Spiral; *f*, Outside lever; *g*, Dashpot; *h*, Dashpot spring.

Fig. 4.

I believe that the first step necessary to secure good governing is that the governor must not have any heavy parts to move, or parts which are subject to heavy forces; in other words, the governor must not be called upon to do much work. This condition is very well met in Corliss engines, where the governor simply acts on a trip gear, but I do not consider it would be well met if the governor acted direct on to the piston valve controlling the steam distribution in the h.p. cylinder of, say, a 2,000 h.p. engine, as the work to be done by the governor would then be heavy, a piston valve of such a size having necessarily rather great mass, the moving about of which would necessitate the governor exerting considerable effort; the friction also would add a considerable amount of work, and if minimised by dispensing with spring rings from the piston valve, there would be considerable risk of leakage, with the attendant result of bad economy and bad governing. The objection to a trip gear is that it cannot be worked satisfactorily at high speeds.

The whole object, then, of the valve gear adopted by Messrs. Ferranti is to permit of high engine speeds, and at the same time put no load on the governor. In fig. 5 *(a)* is the governor; *(b)* the governor lever, one end of which is connected to the spindle of a small piston control valve *(c)*. This control valve has oil under pressure between it, hence, if lifted slightly, the top port is opened, and the oil under pressure is admitted to a port leading to the upper side of the relay piston *(d)*. Thus this piston is forced down. If, on the other hand, the control valve is lowered, the pressure is taken to the bottom of the relay piston, and this is forced up. As already described, this piston is connected to a spiral *(e)* which alters the angle of advance of the cut-off cams and thus changes the point of cut-off. If, then, the speed of the engine rises on load going off, the governor lowers the control valve, and the piston *(d)* is forced up until the cut-off is sufficiently early to balance the reduced load, and *vice versâ* in the case of increase of load.

It will be noted that all the work which the governor does is that of operating a very small piston control valve, which on large engines can easily be worked with one finger. It may, therefore, be reasonably claimed that the principle of removing work from the governor has been fully met. Unfortunately the arrangement as described so far does not fully meet the case, first because it would try to give absolute constancy of speed, and secondly, because it would be difficult to avoid hunting, as the relay piston owing to its quick movement would not just go to the position necessary to balance the load, but would almost certainly overshoot the mark, and thus have to be brought back. Both difficulties have been overcome by the addition of the lever *(f)*, dash pot *(g)* and spring *(h)*. Before explaining the action of these parts I will deviate for a moment to answer a question which naturally arises, viz:—"Why is constancy of speed an objection?" The answer is that for working dynamos in parallel some deviation from isochronous

governing is necessary to secure the equal distribution of load amongst the dynamos. In illustration take the following case:—Two engines each of 1,000 H.P are driving alternators working in parallel; one engine has an isochronous governor, whilst the other has a governor with, say, 6 per cent. range between full load and no load. Suppose each engine to be running at 200 revolutions per minute and loaded to half load, and that 500 H.P. suddenly comes on. The additional load would slow both engines down slightly, the consequence being that the isochronous governor would drop right down to its bottom position and give its engine its maximum quantity of steam, thus causing this engine to take up the whole of the additional load; whereas, had this engine had a 6 per cent. governor like the other one, the governors would have opened out equally and the load have been divided equally. If both governors were isochronous a very unstable condition would occur and the load would have a tendency to flow from one engine to the other.

Turning again to fig. 4 it will be seen that when the relay piston is at the top of its travel the spring *(h)* is compressed considerably, but when the relay piston is at the bottom the spring is much less compressed, thus when the cut-off is late the load on the centre of the governor is much less than when the cut-off is early. Consequently the governor speed is greater at light loads than heavy loads. By means of this small spring the range of the governor between no load and full load can be made anything which may be most suitable for running in parallel with other engines in the same station, and this result is obtained without any material movement of the governor itself. The action of the dash pot also deserves attention. Suppose that the control valve opens at the top. The relay piston moves down, lifting the dash pot piston up. The dash pot cylinder is filled with oil and thus there is a tendency to lift the governor up and cause it to return to its central position, and thus stop the movement of the relay piston. By this means the speed of action of the relay may be made fast or slow as is desired. The oil pressure which works the relay is obtained from a separate valveless pump, and an air vessel is provided to secure practically constant pressure.

With installations including rotary converters, great rapidity of action of the governor is not desirable and is liable to produce hunting at the rotaries. The facility with which the speed of governing can be adjusted, as just mentioned, is therefore very useful in such a case.

On large engines automatic expansion is preferable to throttle governing apart from any question of economy, as very large throttle valves are difficult to keep steam tight and at the same time quite easy to move. When a good fit they are very liable to stick, especially if the engine is not in regular service.

Again, with automatic expansion there is a smaller volume of steam between the controlling valves and the piston than with throttle governing, hence the increase of speed when load is suddenly thrown off is not so great.

Emergency Governor.

To meet the requirements of many electrical engineers an emergency governor has been fitted to the engine. This governor is arranged to come into action at a slightly higher speed than the main governor, and it is connected with an ordinary equilibrium throttle valve; thus in case of the main governor not controlling the speed properly the governing would be taken up by this emergency governor.

It is a fairly common practice to arrange for the emergency governor when it comes into action to shut the engine down, but believing that this is an undesirable course the method of attaching the second governor to a throttle valve is adopted.

To meet any sudden contingency either on the town circuit or elsewhere the fulcrum lever between the governor and the throttle valve is carried from a handle brought down to one of the engine beds. By raising this handle the throttle valve is at once closed; thus a means of shutting the engine down very quickly is provided.

Turning Moment.

In driving alternators it is important that the turning moment throughout a revolution be very regular. With a given fly-wheel energy and number of cranks the higher the number of revolutions per minute the less the variation in speed during a revolution.

Again, not only does higher speed give more regular angular velocity but it also reduces the necessity for extreme regularity. The truth of this will best be seen by taking comparative cases. Suppose an engine to be running at 80 revolutions per minute and driving an alternator. If now, the periodicity of the alternating current were 40 cycles per second, it would be necessary to have 60 poles in the dynamo. Next take the case of an engine running at, say, 240 revolutions, in which case 20 poles would be required for the same periodicity. Again, suppose that a phase displacement of 1 per cent. is allowable, *i.e.*, the time occupied in making each complete alteration can vary 1 per cent. In the slow-speed wheel an alternation occupies $\frac{1}{30}$th part of a revolution, and therefore the allowable angular variation is 1 per cent. of $\frac{1}{30}$th, or ·12 of 1 degree, whilst in the higher speed engine the alternation occupies $\frac{1}{110}$th of a revolution, therefore the allowable variation is 1 per cent. of $\frac{1}{110}$th or ·36 of 1 degree, *i.e.*, practically three times as much as is permissible with the lower speed. We thus see that the higher speed not only of itself naturally tends to give more regular turning but that it also permits of a greater irregularity in the speed. The two things combined therefore enable the high speed engine to give a much better turning moment with the same fly-wheel energy.

The problem of driving dynamos so as to give regularity of speed is very different from that of driving cotton mills, as in the case of the mill engine not only is the wheel on the engine a fly-wheel, but all pulleys, shafts and spindles throughout the mill are acting as extra fly-wheels, and are tending to give regularity in speed. In driving a dynamo there is no such external assistance as regards the fly-wheel problem.

In this paper I have endeavoured to outline the special features in connection with steam engine building which arise when engines are applied to the direct driving of large dynamos, and I have also described the methods which have been adopted in the Ferranti engine with a view to meeting these requirements. I have not dealt with any questions regarding designs of pistons, crossheads, connecting rods, and other parts where the requirements for driving dynamos hardly necessitate special designs. Suffice to say, that we have adopted established designs or modifications of such which have seemed to us best suited for our purpose. The sectional drawing, fig. 1, shows fairly clearly the general design of most of the parts.

CURRENT SPECIFICATIONS.

LXXXI.—WILLESDEN ELECTRIC LIGHTING.

Summary.

Extent of Contract.—Supply, under 11 sections, of the whole of the plant required for the proposed electric lighting installation at Willesden.

Size and Number of Boilers.—Four to be supplied, one to evaporate 5,750 lbs. of water per hour, and to have a heating surface of not less than 1,619 sq. ft., and three to have heating surface of at least 3,580 sq. ft. and an evaporative capacity of not less than 12,500 lbs. per hour.

Method of Firing.—It was originally proposed to have mechanical stokers, but this accessory has now been dispensed with.

Fuel Economisers.—Two to be provided, each of Messrs. Green's design, 192-tube size, the scrapers to be electrically driven.

Superheaters.—To be fitted to each boiler, and to be of approved type.

Boiler Feed Pumps.—One steam-driven pump of Messrs. Weir's or other approved type to be supplied, capable of delivering 3,500 gallons of water per hour against a pressure of 160 lbs. per sq. in. One electrically-driven pump to deliver 2,000 gallons per hour under similar conditions.

Feed Water Heater.—To be supplied and fixed in the path of the exhaust steam of above pump, large enough for three pumps of similar size.

Steam Generating Units.—Two or three to be supplied, at the option of the Council.

Type of Unit.—To consist of vertical compound or triple-expansion engine directly coupled to a double current machine capable of delivering at one end direct currents and at the other end three-phase currents.

Size of Units.—250 or 300 KW., at option of tenderer.

Space Available.—The space available for each set is 19 ft. in length by 9 ft. in width.

Overload.—Engines to be suitable for 20 per cent. overload over normal rated output for two hours without injury.

Working Steam Pressure.—175 lbs. per sq. in., the steam being superheated 120° F.

Even Turning.—The permissible maximum variation from even angular velocity must not exceed one-fifth of 1 per cent. per revolution.

Range of Governing.—Permanent variation between no load and full load 1 per cent., momentary variation if half load suddenly thrown off 2½ per cent.

Dynamo.—To be supplied with commutator at one end and collector rings at the other, the connections being so arranged that the machine will deliver from the same armature winding, continuous and three-phase currents, the ratio of voltage being as 1·73 is to 1.

Output Requirements.—Machine to be capable of delivering:—

(*a*) Full output as dynamo.
(*b*) Full output as three-phase alternator.
(*c*) Any ratio of either up to normal full-rated output.

Periodicity of Three-phase Current.—To be 25 ~ per second.

Permissible Speeds.—250, 300, or 375 revolutions specified, but this may be modified to suit tenderer's designs.

Specified Voltage.—Direct current. As shunt machines 480 to 560 volts at constant speed, as compound-wound machines 500 to 550 volts. As alternator voltage, to be proportionally lower.

Specified Temperature Rise.—Not to exceed 70° F. after 10 hours' full load output.

Specified Combined Efficiency.—Not to be less than 85 per cent. at full load, 83 per cent. at three-quarter load, 80 per cent. at half load, and 70 per cent. at quarter load.

Guaranteed Steam Consumption.—Not to be more than 24 lbs. per KW.-hour at full load, 24·5 lbs. per KW.-hour at three-quarter load, 26·5 lbs. per KW.-hour at half load, and 34·5 lbs. per KW.-hour at quarter load, with full steam pressure, superheated steam and 24-in. vacuum.

Bonus and Penalty.—Bonus and penalty of £100 per lb., or *pro rata* for tenths of a pound, to be paid or charged for variation from the 24 lbs. per KW.-hour demanded at full load.

Transformers.—Six to be supplied, each to be mesh-connected, and suitable for use on three-phase circuits 25 ~ per second.

Ratio of Transformation.—1 to 9, the low pressure side being wound for 290 to 330 volts, and the high pressure side 2,600 to 2,900 volts.

Output of Transformers.—To be either of 83·5 KW. or 100 KW. at option of Council, capable of an overload of 20 per cent. for two hours.

Core Guarantee.—Tenderers must guarantee that after 12 months the core losses shall not exceed the guaranteed figure by more than 10 per cent.

Guaranteed Efficiency.—Ratio of primary to secondary watts expressed in percentage not to be less than 97·8 per cent. full load; 97·8 per cent. $\frac{3}{4}$ load; 97·5 per cent. $\frac{1}{2}$ load; 96·2 per cent. $\frac{1}{4}$ load; 91·5 per cent. $\frac{1}{10}$th load.

Permissible Temperature Rise.—80° F. after six hours' full load run.

Motor-Generators.—Five to be supplied, two of 200-KW. output, two 100-KW., and one 50-KW. output, each capable of 20 per cent. overload for two hours.

Type of Machine.—Each to consist of synchronous three-phase motors 25 ~ directly coupled to continuous-current dynamos.

Specified Speeds.—Not to exceed 500 revolutions per minute for the 200-KW. set, or 750 revolutions for the 50 and 100-KW. sizes.

Voltage of Motors.—2,600 to 2,900 volts.

Voltage of Dynamos.—200-KW. size to be 480—580 volts as shunt-wound machines, or 500—550 as compound-wound. The 100-KW. motors each to drive two 50-KW. machines wound for 240—290 volts, and the 50-KW. to be of similar voltage. When the two 50-KW. machines forming one 100-KW. unit are connected in series with each other, the voltage, as compound-wound machine, to be 500—550 volts.

Balancing Transformers and Boosters.—Two motor-balancers and boosters to be supplied, each consisting of four dynamos directly coupled together. Each of two inner balancer machines to have output of 20 KW. at 240 to 290 volts. Each of two outer booster machines to have output of 33·4 KW.—200 amperes at any voltage between 0 and 167 volts.

Switchgear.—Both high and low tension switchboards, as specified, to be supplied and fixed at the generating station and sub-station.

Size of Cranes.—One for the generating station to lift 12 tons and be suitable for a span of 45 ft. 6 in. The other for the sub-station to lift 8 tons and be suitable for a span of 23 ft. 6 in.

Capacity of Cells.—Two batteries required, one for generating station to consist of 250 cells, each capable of discharging at rate of 42 amperes for 16 hours, or 108 amperes for three hours. The other, for the sub-station, to consist of 250 cells, each capable of discharging at rate of 84 amperes for 10 hours, or 216 amperes for three hours.

Mains.—To be suitable for high tension and low tension systems, and of the sizes and types specified.

Number of Lamps.—94 arcs, mounted on cast-iron posts, on 80 of which two glow lamps are fitted for use after midnight.

Type of Condenser.—One to be provided of the jet type, suitable for dealing with exhaust steam from two generators.

Air and Circulating Pump.—To be driven by independent steam engine, and to be of cross-compound type.

Specified Dates of Completion.—The two cranes in seven months, rest of plant in 10 months from date of order.

Penalty for Late Completion.—One half of 1 per cent. of contract sum per week for first four weeks, and 1 per cent. per week for subsequent weeks.

Specified Terms of Payment.—On monthly payments up to 75 per cent. of value of work delivered on site, in successive months, until total value thus paid equals 90 per cent. of contract sum, 5 per cent. on completion, 5 per cent. 12 months later.

Period of Maintenance.—12 months from date of completion.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—None.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—November 12th, 1901.

This specification has been prepared by Mr. E. T. Ruthven-Murray, M.I.E.E., the electrical engineer to the Willesden District Council. The scheme, as originally drawn up, invited an additional generating unit in the first instalment of plant, an additional condensing unit, mechanical stokers to the boilers, and an extra boiler-feed pump, and it seems a pity that such a reduction in the contemplated first instalment of plant has been made. As in so many other cases, we fear that the Council will have reason to regret this decision, and will find the course they have adopted the most expensive in the end.

In many respects this is one of the most interesting specifications we have seen for some time. The plant asked for is of smaller capacity than that required for the Central Electric Supply Company, Manchester, and the London County Council, but Mr. Murray has shown such originality in his method of dealing with a difficult problem that his scheme deserves very careful attention.

The district to be supplied is one of those scattered municipal areas in the north of London where the possibilities of growth in importance and population are very great. The distributing network is arranged for a three-wire direct current system, having 240 volts between the neutral and outer conductors.

The generating station is situated near one end of the area, and forms the centre of distribution for that part of the district. At a point approximately $2\frac{3}{4}$ miles distant a sub-station has been arranged, which practically acts as a subsidiary generating station. Here a large battery is to be installed, motor-generators to a total capacity of 550 KW., a battery booster, and the switchboards and accessories required to complete the equipment of the station.

These motor generators will be driven by three-phase synchronous motors supplied with current at a periodicity of 25 ~ per second, transmitted from the main generating station at a pressure of 2,950 volts.

The actual generating units will be of either 250 or 300 KW. output, and consist of steam engines directly coupled to double-current machines, similar in general design to rotary converters, from the armature winding of which direct currents may be taken off at the commutator at one end of the machine and three-phase currents from the slip-rings at the other. The ratio of the voltages of the two classes of current is given as 1 : 1·73, apparently under the erroneous supposition that $\sqrt{3}$ has something to do with the matter. A ratio of 1 : 1·6 would be more reasonable. The three-phase currents are passed through transformers, which raise the voltage to that required for transmission through the underground cables to the sub-station.

The same engines therefore supply both stations, and the ratio of power supplied from the same machine to either station may be varied to any extent without impairing the efficiency of the system.

The usual accessories to a three-wire station, cells, boosters, &c., are also in evidence at the main generating station. We have, therefore, practically two stations fed by the same steam plant, the efficiency of which increases with the demand for either part of the area.

A somewhat similar idea was adopted by Mr. Rider at Plymouth, where the same engines drive either alternators or traction dynamos, but there the electrical machines are quite distinct from each other.

The general conditions are, on the whole, of a fair character, following in regard to such items as arbitration, terms of payment, &c., the model clauses as agreed upon between the representatives of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association.

It is stipulated that without the consent of the contractor the contract price shall not be varied during the progress of the work by more than 10 per cent. This we consider a very useful stipulation, and one which might with advantage be universally acted upon in electrical engineering contracts.

The penalty for late completion is graduated, *i.e.*, one-half of 1 per cent. for the first four weeks in default and 1 per cent. per week afterwards.

We advise tenderers to read carefully the various clauses relating to tests after completion. These are of a very comprehensive character, and need consideration when the price is fixed.

AMERICAN COMPETITION AS IT REALLY IS.

During the past few months we have had frequent opportunities of seeing something of English work and arriving at approximate conclusions on the value of American competition. We have found many English workshops doing capital work, work that is not exceeded in excellence or durability by any American manufactures; in fact, which puts American work entirely in the shade in both material and workmanship. But we find that the methods of doing it are expensive, that still better work would result if more modern systems could be adopted. We are convinced that no good can come to English trade by dropping the commendable qualities that have always distinguished it, but that much benefit would arise from an improvement in methods of manufacture, from better arrangement of machine tools, the employment of machines capable of doing work more rapidly, and the adoption of modern systems of gauge working.

We do not consider it desirable to aim at doing work so quickly as it is done in America unless there are sound reasons for this. There are no valid reasons, for example, why our engine makers should bore out a cylinder as quickly as it would be bored out in an American shop. We have previously pointed out that in the United States everything is sacrificed to shop work. Not simply bedplates, but slide bars and cylinders, are made of the softest and most tractable of cast-iron. The result of this practice is known to those of our readers who have to do with American engines. Thus the machine work may be good and accurate, but this is not enough. Steam engines should not wear out in two or three years. We saw lately some cylinders from an English engine that had run for five years, and they were as good as new, smooth and unscored.

The insufficient material and quality of American manufacture has now been tried for a few years in locomotives in Japan and elsewhere, and the English work has come out on top. Yet we do not doubt that the American engines were made on a better principle as regards machine work, and that, did English locomotive builders follow American lines so far, they would be able to compete more easily in uneducated markets; 10 years ago or so Japan, for example, was an uneducated market that had not had opportunities of comparing English locomotives with others, and so became a large purchaser of American engines.

American work will often be very well designed, and surprising results will be obtained from small amounts of material, but durability is not a prominent feature. Americans have acquired the habit of tearing out new machinery and replacing it with better about every two years, so that they have come to think it the proper thing for machinery to wear out in a year or two, and this they live up to very fairly in many cases. Now, if a machine is intended to be scrapped in five years, it need not be good enough to last 25. At the same time, it does require to be good enough to do accurate work, if a machine tool, during such time as it is at work.

We are confident that the craze for scrapping new plant has been overstretched, but the frequent cause of it lies in protective tariffs. If, because of a policy of protection, a manufacturer can earn for a given article £1,000 where the value is really only £700, there is a gain of £300, and to secure this gain by means of the most rapid manufacture, it may pay to put in plant of a slightly greater capacity of output where it would not pay if the extra £300 could not be earned. The conservatism of employers and the false ideas of trades unions have been responsible for the stagnation of English methods of doing work, and we should like to see these methods modernised. They are being modernised in some shops, and we believe a slow improvement is coming over things. It is fortunate for our manufacturing engineers that their American competitors are as blind in certain directions as the English engineers are in others. Americans are so full of their own perfection that they cannot bear the slightest criticism. If a piece of American work be criticised, the critic receives the most intolerant abuse. Thus it is that Americans throw away the advantages they have secured to themselves by their methods, for they fail to secure quality. Their wares are, perhaps, mechanically good, they look well, are made perhaps promptly to time, but they do not possess the quality of durability, and this is the quality that has made English work respected the world over, and that should not now be dropped.

If English engineers attempt to meet foreign competition by cutting down design and material, they will have real competition. We feel strongly that they should resist this tendency, but we feel equally strongly that they should overhaul their methods.

The cost of work is largely a matter of tools, methods and systems, and is distinct from the quality of the work. Now, are our engineers going to learn order and method, and good shop practice, before the Americans learn liberal design, and the secret of durability? At present American locomotive men are busy calling their critics fools, and saying that the Midland Railway of England have not secured a genuine American engine, and generally are illustrating the French proverb, "*qui s'excuse s'accuse.*" But the time may come when Americans will realise their imperfections and shortcomings. They will then adopt British ideas of work, and graft them on their own improved shop methods. We shall then have real competition to face. At present American competition is only just what British engineers permit it to be by their neglect of principles, their dirty shops and costly disorganisation.

The success of American competition has caused a very severe epidemic of swollen head among the Americans, and they have presented the ridiculous picture of a nation behind a 50 per cent. wall of tariffs, shouting that they can whip the world. Yet Americans consider themselves a humorous people. We cannot help laughing at so inconsistent an attitude, just as we are fain to smile at some of our own manufacturers who grumble at foreign competition, and yet hang on to methods of doing their work that are an outrage on common sense. We should be glad if it were impossible to turn out good sound durable work with such old time methods as we find still pursued. In America it is, we believe, found to be impossible to do good work without good tools and modern methods, but this is because of the labour.

There is not sufficient skilled labour in America of the special kind that is necessary where machine building is, as with us, an art, and not a process. In America it is a process, and generally speaking, it always has been. Here it is still, to a great extent, an art, the lineal descendant of the old handicraft days. But even the Amalgamated Society of Engineers has now decided to admit machine workers into its ranks. The machine worker has hitherto been a pariah outside all recognition by the ranks of the apostolic successors of the craftsmen. By doing this, the A.S.E. has stolen a march on the employers, and it is to-day, and has been since 1897, the employers who are to blame for want of progress, for we only find amongst firms who do not really want to make progress that the old policy of restriction is holding its own. The best firms in the country to-day are those that insist on managing their own shops, and do it, and will not be ordered about by irresponsible outsiders. The employers who are doing this are those who are most alive to new methods and are most up-to-date. At the same time we note that they have abated nothing of the established English quality, and American, or any other competition, has no terrors for them. But as we point out above, the American may also pull his head out of the sand and find that shopwork and methods are not the sole factor necessary in a good machine. It cannot be disputed that there are some shocking examples of mechanical depravity sent over here from America. The really good and first-rate makers are in the minority.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

21,031. "Improvements in and connected with the supporting standard and trolley arm used in overhead electric traction schemes." R. L. Ross. October 21st.

21,056. "Improvements in or relating to electric arc lamps." The Jandus Arc Lamp and Electric Company, Limited, and A. D. Jones. October 21st.

21,092. "Improvements in coating tubes by electro-deposition." J. Greenwood. October 21st.

21,170. "Improvements in electric cables." M. J. P. O'Gorman. October 2nd.

21,205. "Improvements in or connected with electricity meters." J. G. Lorrain. (H. A. Macdonald, France.) October 22nd.

21,226. "Improvements in ball fittings for electroliers, brackets, and analogous fittings employed in electric lighting." H. Wakefield. October 23rd.

21,253. "Improvements in automatic time switches." C. H. Offord and S. Jevons. October 23rd.

21,262. "Improvements in portable electric lamps." O. F. Herrmann. October 23rd.

21,328. "A waterproof cone, cap or cover, for protecting the holders of electric glow lamps." S. Miller. October 24th.

21,333 "Improvements in electric measuring instruments." A. R. Hakoumoff. October 24th.

21,336. "Incandescent gas lamp fittings." A. E. Podmore and J. Thomas. October 24th.

21,485. "An improved system of electric conductors." G. C. Hurrell. October 26th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1900.

164. "Improvements in or in connection with incandescent lamps." C. M. Stead and G. F. Carr. Dated January 3rd, 1900. A central reflector, surrounded by a filament, may be cylindrical, spherical, conical or conoidal, and may be supported by a thin glass stem from either end of the bulb of the lamp. Or the lamp bulb may be of annular form, enclosing the filament, and having an open recess to receive the reflector. The reflector may be of opal or silvered glass, and may be ribbed or otherwise serrated. The filament may be a single coil formed similarly to the reflector surface, or three or four filaments may be supported independently near the reflector.

184. "A new or improved method of determining the voltage obtaining at a near or distant part of an electric circuit, or the average voltage." M. B. Field. Dated January 3rd, 1900. Current meters. Multiple wire or feeder systems are provided with means for indicating pressures at distant points. Electrometers. A low-pressure electrometer may be used to indicate the pressure between distant parts of two high-pressure feeders.

216. "Improved manufacture of active mass for accumulator batteries." R. Rodrian. Dated January 3rd, 1900. Relates to the use of peroxide in the manufacture of electrodes.

246. "Improvements in automatic electric switches or cut-outs." F. H. Headley. Dated January 4th, 1900. Relates to a minimum magnetic cut-out. The connecting bridge of a lever is fitted with a catch adapted to engage with a latch on one end of a lever, the other end forming the armature of a series electro-magnet. A spring tends to force the armature away, and, should the current fall below the minimum, the armature springs out and the catch is released. A spring then operates the circuit breaker. In a maximum cut-out, the catch is held when the armature is away from the core, and an increased current attracts the armature and releases the catch.

261. "An improvement in safety electric fuses." H. C. Gover and J. M. Moffat. Dated January 4th, 1900. Relates to cut-outs adapted for high-tension circuits.

262. "System of intercommunication between trains and railway stations and vice versa, and between the trains themselves." L. A. Mangin. Dated January 4th, 1900. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, June 6th, A.D. 1899.) Relates to a system of intercommunication between railway trains and stations, and *vice versa*, and between the trains themselves. The signalling or telegraphic messages are transmitted by alternating induced currents of high potential, from transformers which may be of the Tesla, d'Arsonval or other suitable type, or by Hertzian radiations, and are received in a circuit containing a coherer, or a resonator, or telephone, &c. The coherer is interposed in the circuit of a battery, or of a relay, which may actuate a bell, or a telegraphic apparatus, and a vibrator adapted to decohere the filings of the coherer after each passage of the current. The current may be sent directly into the line-wire by connecting one pole of the transformer to earth and the other to a light brush or trolley, which makes contact with the line, or it may be sent without direct contact by long sparks of Hertzian radiations.

367. "Improvements in or relating to the means for adjusting or regulating the shades or covers employed in connection with electric lights, gas lights and others for the purpose of concentrating and diffusing the light therefrom in any desired direction, and apparatus for effecting same." M. I. Crankshaw, A. Crankshaw, and H. Crankshaw. Dated January 6th, 1900. The adjustment of candle shades or of electric, gas, and other lamp shades is effected by a chain terminating in hooks or clips, of which the hooks engage the edge of the shade, and vary its angle according to the position of the adjustable clip upon a support. The length of the chain may be regulated by inserting therein screws and nuts of their equivalents, and the hooks or clips may be coated with insulating or pliable material.

371. "Improvements in the manufacture of graphitic carbon." F. Schmidt. Dated January 6th, 1900. Graphitic carbon, for use as electrodes, is prepared by saturating cellulose, paper, pasteboard or the like with tar, embedding it in carbon powder, and heating the mixture to redness, while a carbon-containing gas or vapour is sent through the red-hot mass.

596. "Improvements in electricity meters." M. Behrendt. Dated January 6th, 1900. A commutator meter is constructed as follows:—A rotatable spindle carries a shunt armature consisting preferably of four radial coils in the field of stationary main current coils and also carries a brake and a commutator. Opposite coils of the armature may be connected in series between opposite contact plates on the commutator, or the armature coils may be connected in closed circuit, and one end of each to a contact plate. The commutator is situated between two contact springs carried by insulated parts of an aligning shaft which can oscillate through some distance, current being supplied through bearing springs. Another aligning shaft carries an iron bar armature of a stationary electro-magnet, and is controlled by a spring which tends to turn the bar away from the poles of the electro-magnet. The contact plates of the commutator are recessed, so that in turning it turns the contact spring and first aligning shaft until a projection on first spring strikes a contact on the iron bar armature; current then passes through the electro-magnet, turning the iron bar armature quickly and with it the first contact springs and first aligning shaft in a backward direction, the springs slipping round the commutator. This action is repeated every quarter revolution of the armature. The iron bar armature operates counting gear. The first aligning shaft may be acted on by a light spring, tending to turn it forwards to facilitate starting with a small load. In modifications, the contact springs may be carried by a sleeve loose on the rotatable spindle, current being conveyed to them by two flat spiral springs. The iron bar armature may carry a curved contact plate, which slides past a stationary spring, and is arranged in series with the contact on the iron bar armature so that contact is made between the latter and the first contact spring but broken between the curved plate and the stationary spring. The iron bar armature may be oscillated by alternate action of two electro-magnets, or by a spring or weight released by an electro-magnet.